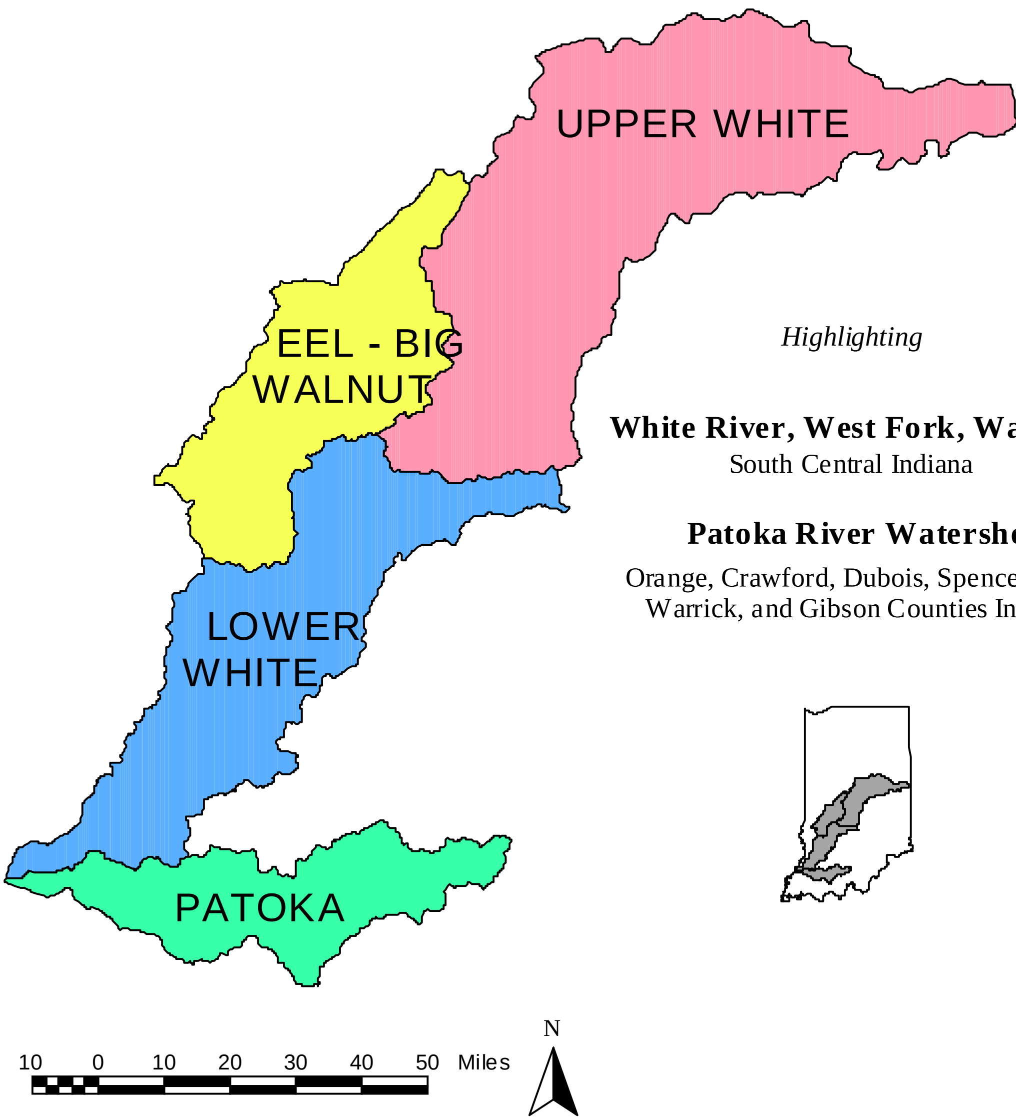
INDIANA WATER QUALITY REPORT

1998



Highlighting

White River, West Fork, Watersheds
South Central Indiana

Patoka River Watershed
Orange, Crawford, Dubois, Spencer, Pike, Warrick, and Gibson Counties Indiana

Indiana Department of Environmental Management
Office of Water Management
Planning Branch
Indianapolis, Indiana

IDEM/34/02/002/1998

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PART 1

Executive Summary

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EXECUTIVE SUMMARY

Section 305(b) of the federal Water Pollution Control Act (the Clean Water Act most recently amended in 1987) requires states to prepare and submit to the U.S. Environmental Protection Agency (U.S. EPA) a water quality assessment report of state water resources every two years. The Indiana Department of Environmental Management (IDEM), Office of Water Management, has prepared this report to meet the reporting requirements of Sections 106, 305(b), 314, and 319 of the Clean Water Act. The report has two parts.

Part 1 provides **Background, Surface Water Assessment and Ground Water Assessment** information following guidelines provided by U.S. EPA (1997a).

- A **Background** overview of Indiana surface waters, point and nonpoint control programs and monitoring plan.

- **Surface Water Assessment** perspective on water quality evaluation including changes since the last report with a map of monitoring areas for each basin rotation.

- **Ground Water Assessment** for Indiana hydrogeologic settings with a comprehensive approach to assess ground water quality.

Part 2 provides **Waterbody Assessments** for stream and lake watersheds updated for this year. A map of monitoring locations and designated use support conclusions for 16 percent of Indiana's watersheds updated this year are included.

- Upper White 05120201
- Lower White 05120202
- Eel-Big Walnut 05120203
- Patoka 05120209

A new surface water monitoring strategy was implemented in 1996 with the goal of monitoring all waters of the state by 2001 and reporting the assessments by 2003. Each year approximately 20 percent of the waterbodies in the state will be assessed and reported the following year. Significant changes since 1996 are included in this abbreviated report of Indiana water quality. "Indiana 305(b) Report 1994-95" provides the most recent comprehensive report on Indiana water quality and is the baseline report for areas of the state for which water quality assessments have not yet been updated (IDEM 1994-95).

A new comprehensive report on Indiana water quality will replace the 1996 baseline report after the five-year rotating basin monitoring and comprehensive assessment of Indiana surface waters are completed. Indiana has elected to submit annual electronic updates to U.S. EPA with an abbreviated written report submitted in even numbered years.

Support of designated uses was determined for each stream and lake waterbody using U.S. EPA assessment guidelines. The Indiana Trophic State (or eutrophication) Index, a modified version of the BonHomme Index developed for Indiana lakes in 1972, was applied to inland lake data.

Results from the following five monitoring programs were integrated into one assessment for each waterbody.

- Physical/chemical water column results (lakes and streams).
- Benthic aquatic macroinvertebrate community assessments (streams).
- Fish tissue and surficial aquatic sediment contaminant results (lakes and streams).
- *E. coli* monitoring results (streams).
- Indiana Trophic State Index (lakes).

Approximately 16 percent of the stream miles in the state were monitored and assessed for support of aquatic life, fish consumption advisories, and full body contact recreation (swimmable). Of the stream miles assessed, aquatic life use was supported in 79.2 percent and full body recreational use (swimmable) was supported in 78.7 percent. One hundred percent of Indiana's Lake Michigan shoreline and the inland lakes assessed supported aquatic life use; although 50 percent of the inland lakes appear to be threatened. The Lake Michigan shoreline partially supported full body recreational use (Table 1).

The Indiana State Department of Health has issued a general fish consumption advisory for carp in all Indiana rivers and streams. All Indiana streams, the Indiana portion of Lake Michigan, and inland lakes assessed for this report have some fish consumption advisory (ISDH 1997). Therefore, Indiana has zero stream miles, zero Great Lakes shoreline miles, and zero inland lake acres which fully support aquatic life use as measured by fish consumption advisories (Table 1).

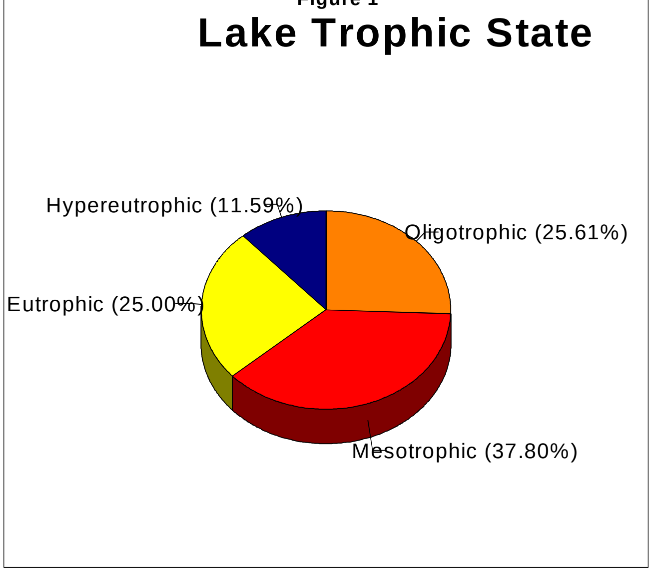
Table 1
Summary of Use Support
(all values rounded to three significant digits)

Designated Use	Support	Threatened	Partial Support	Non Support	Assessed	Not Assessed
Rivers - in miles						
Aquatic life use	5,390	419	720	808	7,300	28,300
Fish consumption*			2,600	478	3,030	32,600
Swimmable	3,150	60	179	690	4,080	31,700
Great Lakes shoreline - in miles						
Aquatic life use	43					0
Fish consumption			43			0
Swimmable			43			0
Lakes, Reservoirs - in acres						
Aquatic life use	6,730	6,730				92,700
Fish consumption*			43,200	1,960		61,100
Swimmable						106,000

Source: Indiana Waterbody System 1998. *Only waters for which fish tissue data support issuance of fish consumption advisories are classified as partial or nonsupport above. The Indiana Department of Health has issued a general fish consumption advisory for all other waters of the state. See Indiana Fish Consumption Advisory issued by the Idiana State Department of Health for health advisory descriptionxs.

One hundred sixty-four publicly owned lakes were monitored in 1996-97 and assessed using the Indiana Trophic State Index. Forty-two lakes were classified as oligotrophic; 62 lakes were classified as mesotrophic; 41 lakes were classified as eutrophic; and 19 lakes were classified as hypereutrophic (Figure 1). Of the monitored lakes, 9.1 percent were improving; 43.9 percent were stable; and 14.4 percent were degrading. There was no apparent trend for 33.5 percent of the monitored lakes.

Figure 1



Causes of nonsupport are reported for each waterbody type: rivers, lakes, and Great Lakes shoreline. Mercury and polychlorinated biphenyls (PCBs) in fish tissue which resulted in fish consumption advisories were the predominating cause of nonsupport of streams and lakes, including Lake Michigan. Pesticides, priority organics, unionized ammonia, cyanide, low dissolved oxygen, chlorides, non-flow habitat alteration, pathogens (*E. coli*), and oil and grease were other causes of partial or non support of aquatic life use and full body contact recreational use (swimmable).

Fish tissue and surficial sediment were monitored for the presence of toxic pollutants. The Indiana Fish Consumption Advisory identifies fish species which contain toxicants at levels of concern for human consumption. The Great Lakes sport fish risk based approach was used to evaluate PCB contamination (Anderson 1993). As fish tissue and sediments from additional watersheds are analyzed for contaminants, it is expected that the miles of impaired streams and acres of impaired lakes and reservoirs due to fish consumption advisories will increase for the near term.

Including fish consumption advisory pollutants on the causes list with other impairment causes, obscures stressors and pollutant causes other than mercury or PCBs. This leads to a reporting of causes biased toward the pervasive fish consumption advisories causes/ stressors. For many of these waters there are no identified sources of these contaminants (other than air depositon).

Wetland resource gain or loss has not been evaluated since 1991. Wetlands were reclassified for this report using Cowardin's system. A study designed to evaluate the effectiveness of compensatory wetland mitigation for sites with Clean Water Act Section 401 certification from

IDEM is underway. This study is expected to provide information for wetland water quality standards.

Indiana revised state water quality standards for those waters in Indiana's Great Lakes basin after the final Great Lakes Water Quality Guidance was issued in 1995. The various criteria and procedures (or equivalent ones) identified in the Guidance were incorporated into Indiana's water quality standards and adopted by the Indiana Water Pollution Control Board effective in February 1997. Indiana is still awaiting formal approval of these revisions by U.S. EPA.

Water quality standards, including proposed sediment and wetland narrative criteria, for the area of the state outside the Great Lakes Basin are under development at this time. Considerable macroinvertebrate and fish community data are being evaluated for the purpose of developing biocriteria. Indiana is currently working with U.S. EPA Region 5 and other Region 5 states to develop nutrient criteria for different water body types throughout the Region affected by both point and nonpoint pollution.

Point source discharges are permitted under the National Pollutant Discharge Elimination System (NPDES). Indiana has a goal of processing over 400 administratively extended permits. The permitting project is on schedule to process these permits and remove this backlog by June 30, 1999.

Nonpoint pollution problems were addressed during 1996 and 1997 through 58 nonpoint source pollution control projects. These projects were supported with federal funds totaling $4,450,000.

The Wildcat Creek Watershed, with an area of 803 square miles in central Indiana, has been chosen as a pilot for implementing watershed management practices. Several urban centers, extensive agricultural activities, and the presence of impaired streams which do not meet designated uses presents a unique opportunity for integrating various IDEM programs with local and regional water management initiatives.

Waterbodies which provide partial support or do not support their designated use are reported to U. S. EPA every two years as required by Section 303(d) of the Clean Water Act. IDEM Office of Water Management prepared and submitted to U.S. EPA the 1998 updated list of waters of the state which do not meet Clean Water Act goals. The Clean Water Act Section 303(d) list of impaired waters for 1998 appears in this report.

Approximately fifty percent of Indiana's population served by public water supplies depend on ground water as a source. The major sources of ground water contamination in Indiana are commercial fertilizer application, confined animal feeding operations, underground storage tanks, surface impoundments, landfills constructed prior to 1989, septic systems, shallow injection wells, industrial facilities, materials spills, and salt storage and road salting. Ground water protection programs are being implemented through the efforts of five state agencies with 60 percent of the program activities fully established on December 31, 1996.

BACKGROUND

Introduction

Indiana is located on the eastern edge of the North American great interior plains. The North - South continental divide traverses through northern Indiana draining watersheds into the Great Lakes basin and the Mississippi River and Ohio River systems. Surface water in the northern one quarter of the state flows north into the Great Lakes and then through the St. Lawrence River to the Atlantic Ocean. The southern three quarters of the state drains into the Ohio River or Illinois River and flows into the Mississippi River then south to the Gulf of Mexico. There are about 90,000 miles of rivers, streams, ditches, and drainage ways in Indiana of which 35,673 miles are listed in U.S. EPA River Reach File 3 (RF3). State water types are described in Table 2. Water information for this table was provided by U.S. EPA. Additional state statistics may be found at the State of Indiana internet site http://www.state.in.us/sic/HTML/general_facts.html.

Table 2
Atlas

Description	Value	Units
Indiana population	5,803,000	
Indiana surface area	36,291	sq. mi.
Total miles of rivers and streams (from U.S. EPA River Reach File 3)	35,673	miles
Number of publicly-owned lakes/ reservoirs/ ponds	575	
Publicly-owned lakes/ reservoirs/ ponds	106,205	acres
Great Lakes	154,240	acres
Great Lakes shoreline	43	miles
Fresh water wetlands	813,000	acres

Source: (U.S. EPA and the Indiana State Library)

Water Pollution Control Program

Indiana has adopted a watershed approach to water quality planning, monitoring, assessment, reporting, protection, and restoration. Water quality standards have been adopted for the Great Lakes Basin watersheds within the state; standards for the remaining waters of the state are being revised at this time. National Pollutant Discharge Elimination System (NPDES) permitting is the primary point source control process used in Indiana. Nonpoint source pollution is addressed through watershed management and planning projects. Wildcat Creek Watershed has been chosen for a pilot project to integrate pollution control management through cooperation with local agencies and interested groups.

Watershed Approach

A statewide rotating-basin approach to watershed management has been adopted. Monitoring programs began using the rotating-basin approach in 1996. Permitting programs are integrating the rotation into permit renewal schedules beginning this year. Planning and watershed nonpoint management programs will use data and information provided by the basin approach for watershed management and planning. This will result in updated information being used each year for permitting and watershed management.

The Abbreviated Report on Indiana Water Quality submitted to U.S. EPA in even numbered years in compliance with Clean Water Act Section 305(b) will provide the basis for watershed planning and management. This report represents the first year of the new reporting cycle. An electronic update will be submitted each year with an abbreviated written report in even numbered years. A comprehensive report of waters of the state may be found in "Indiana 305(b) Report 1994-95" which serves as the baseline comprehensive report. Annual updates for the basin of interest and other areas which have undergone significant change or for which significant new data has been assessed will be reported in the abbreviated written reports.

Water Quality Standards Program

Indiana's water quality standards underwent significant revision in 1990. At that time, numerical criteria for all pollutants for which U.S. EPA had developed either human health or aquatic life ambient water quality criteria were added to the standards. Procedures for developing additional criteria were also included in these rules. Additionally, all waters were designated for full body contact recreation and the bacteriological indicator organism was changed from fecal coliform to *E. coli* to conform to U.S. EPA's guidance on bacteriological indicators. All waters, with the exception of 34 streams or stream reaches that were designated for Limited Use, were designated for warm water aquatic life use, full body contact recreational use, public water supply (where there are drinking water intakes from surface waters), industrial uses, and agricultural uses. Certain waters, where natural temperature conditions will support cold water fisheries, are so designated. For those waters where multiple uses exist, the criteria that support the most stringent uses must be met. The 34 streams or stream reaches designated for Limited Use were placed in this category through Use Attainability Analyses which confirmed their inability to support the full aquatic life use due to natural low flow conditions throughout much of the year. Thus, all waters in the state currently are designated for uses consistent with the requirements of the Clean Water Act or U.S. EPA's implementing regulations and have criteria appropriate to support these uses.

In 1993, Indiana's rules and regulations which guide the implementation of Indiana's water quality standards into Indiana's NPDES permits were extensively revised. Although this resulted in significant changes to these rules, only minor changes to the water quality standards were made.

With the issuance of the final Great Lakes Water Quality Guidance in 1995, Indiana began the process to revise its water quality standards and implement regulations for those waters in Indiana's Great Lakes Basin. Many of Indiana's waters are located outside the Great Lakes Basin and this rulemaking, for the most part, had no immediate effect on these waters. These revisions incorporated the various criteria and procedures (or equivalent ones) identified in the Guidance into Indiana's water quality standards. As a part of this rulemaking, Indiana also developed procedures to implement the antidegradation policy for all substances discharged to waters in the Basin. These revisions were adopted by the Indiana Water Pollution Control Board effective in February 1997 and submitted to U.S. EPA for approval. Indiana is still awaiting formal approval of these revisions.

Indiana is currently in the process of reviewing/revising the water quality standards applicable to waters in the rest of the state. Indiana is proposing to incorporate some aspects of the Great Lakes Water Quality Guidance into the water quality standards applicable to waters outside the Great Lakes Basin with modifications where necessary. The criteria and methodology to calculate criteria represent the most recent scientific thinking on how to incorporate the existing toxicity data into criteria and should replace the existing criteria and calculation procedures that Indiana currently uses. Indiana is also proposing to incorporate into NPDES permits at least some of the procedures for implementing the water quality standards that were adopted for the Great Lakes Basin. A proposal to adopt an antidegradation implementation procedure for all substances for waters outside the Great Lakes Basin which is similar to that adopted for waters in the basin is also under consideration.

Indiana has collected considerable data on the macroinvertebrate and fish communities in many Indiana waters and is in the process of analyzing and evaluating the data for the purpose of developing biocriteria. Although Indiana is not at the stage in the evaluation of these data to propose numerical biocriteria at this time, narrative biocriteria language which would allow the state to utilize the available data to assess the biological integrity of aquatic communities is proposed at this time. Indiana hopes to be ready to propose numerical biocriteria for at least some types of waters in the next triennial review cycle.

IDEM is proposing to add water quality standards for wetlands during this review period. These standards would include narrative criteria, designated uses and an antidegradation policy and implementation procedure.

A narrative sediment quality criterion for all waters has also been proposed by IDEM in this review period. The proposed narrative standard addresses both historical sediment contamination problems and the prevention of sediment contamination in the future.

Indiana is currently working with U.S. EPA Region 5 and the other Region 5 states to develop nutrient criteria for different water body types throughout the Region as directed by the Clean Water Action Plan. The plan calls for the development of nutrient criteria by the end of the year 2000 and for the states to put these criteria into state water quality standards in the next triennial review period. Indiana plans to actively participate in this process.

Point Source Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the National Pollutant Discharge Elimination System (NPDES). All facilities which discharge to Indiana waters must apply for and receive an NPDES permit. Unpermitted dischargers and permittees out of compliance may be referred for enforcement action. The limits, set in the permit, are designed to protect all designated uses of the lake or stream into which the discharge flows. The permitting program, in conjunction with wastewater treatment plant inspections, operator assistance and training, compliance data tracking, and enforcement programs forms the point source control program for Indiana. In order to meet the goals of the Clean Water Act, federal, state, and local governments, as well as industry, have made considerable investment in equipment and facilities to improve the wastewater treatment they provide.

The permitting program has focused on issuing new and renewal permits within state required time frames. On January 1, 1998 there were over 400 administratively extended NPDES permits. These are permits which have expired, but which have been extended by IDEM. The permittee is allowed to continue discharging under the expired permit limits. Additional resources have been added to the permit writing process in order to alleviate this large backlog of permit requests. The Office of Water Management has a goal of processing all backlogged permits by June 30, 1999.

The NPDES permitting program is augmented by groups which permit industrial pretreatment and urban wet-weather discharges. Industrial wastewater pretreatment permits are issued to industries that discharge their waste waters to a municipal sewer collection system. The group oversees and audits pretreatment programs that have been delegated to more than 45 municipalities with industrial dischargers. Municipal storm water collection systems and storm water associated with construction and industrial activities are now regulated by permits. A strategy for managing and maintaining combined sewer collection systems is in the process of being implemented. The goal of these additional permitting and management activities is to reduce untreated discharges to surface water.

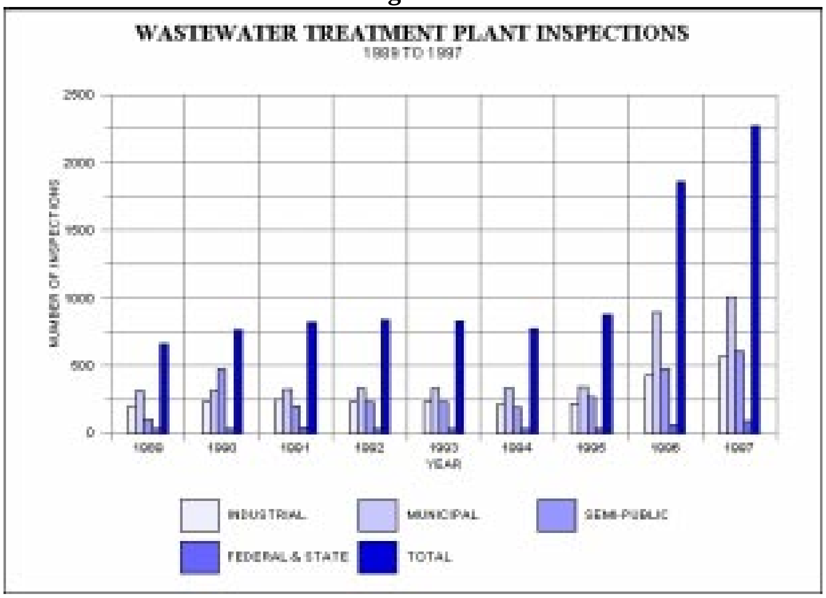
Toxic pollutants are addressed by permit limits for discharge of specific chemicals and by whole effluent toxicity limits. Technical support for wasteload allocation modeling, monitoring, permit compliance, and facility operation are provided by other Office of Water Management groups. These branches and sections work closely with the permitting program to ensure that permit limits are adequate for protection of designated uses and that dischargers remain in compliance with these limits.

Dischargers in the Great Lakes Basins must now comply with Indiana’s water quality standards for Great Lakes waters. Permits for dischargers within the Lake Michigan and Lake Erie basins are written to incorporate Indiana’s water quality standards implemented as a result of the Great Lakes Initiative (GLI).

The point source control program has initiated a project to identify NPDES point source outfalls in Indiana by global positioning system. This project will provide better locational information for U.S. EPA’s Permit Compliance System and ultimately for monitoring, modeling, and designated use evaluation of lakes and streams. Indiana wastewater treatment plant inspectors are providing the position coordinates using handheld global positioning system units whenever they visit a site with a location which is not already verified in the Permit Compliance System.

Indiana wastewater treatment inspections have increased three fold over a nine year period (Figure 2). Inspectors review operation and maintenance of wastewater treatment plants permitted under the National Pollutant Discharge Elimination System. They can provide referrals for operator assistance and training, and for enforcement action as needed.

Figure 2



NPDES permits are the focal point of the point source control program. A major effort is being made to stay in contact with permittees through the inspection program. Regulatory efforts are also focused on urban point sources such as pretreatment and combined sewers which are just beginning to be regulated in Indiana. The project to locate all NPDES discharge points should provide valuable information for monitoring, assessment, and compliance programs. The recent change in monitoring strategy to a rotating basin approach is expected to provide a baseline of water quality information for the state within five years. The new surface water monitoring strategy provides a framework for implementing and measuring the effectiveness of point source controls for Indiana surface waters.

Nonpoint Source Control Program

The IDEM Watershed Management Section is responsible for implementing Clean Water Act Section 319 programs for nonpoint source water pollution control in Indiana. IDEM Office of Water Management is in the process of updating the Indiana Nonpoint Source Management Plan. Activities which will continue to be implemented by this Section are: Nonpoint Source Management Plan and Assessment Report, strengthening partnerships, targeting funds to restore impaired watersheds, providing technical assistance and training to watershed groups, developing outreach programs, and coordinating the Clean Lakes Program.

Projects to remediate or protect watersheds from nonpoint sources of pollution may be funded by Section 319, Section 104(b)(3) or Section 604(b) grants. Activities managed by IDEM and funded with 1996 and 1997 federal funds are listed in Table 3.

Table 3
Nonpoint Source Projects
Administered by IDEM (1996-1997 funds)

Funding Source	Number Projects 1996 - 1997	Total Funding ($)
Section 319 grant	40	3,100,000
Section 104(b)(3) grant	10	700,000
Section 104(b)(3) Coastal Environmental Management	3	470,000
Section 604(b) grant	5	180,000

The Watershed Management Section has organized and supported a multidisciplinary effort aimed at updating the Indiana Nonpoint Source Management Plan and Assessment Report. Representatives from industry, agriculture, academia, nonprofit organizations, and local, state and federal agencies are working to build consensus on the direction the state should take over the next five years to prevent, reduce, control, and abate nonpoint source pollution in Indiana.

Wildcat Creek Watershed Initiative

The Wildcat Creek Watershed, which drains 803 square miles in central Indiana including Kokomo, Frankfort and part of Lafayette, has been chosen to pilot a cooperative watershed approach to pollution abatement. Other state, local, and federal agencies, along with community groups are cooperating with IDEM to plan and implement pollution control ideas in the watershed. Land use in this 8-digit hydrologic unit area is 90 percent agricultural with numerous tributaries channeled for agricultural drainage. The stream flows through seven counties from its headwaters in western Grant and Madison counties to its confluence with the Wabash River southeast of Lafayette.

Portions of Wildcat Creek and Wildcat Creek, South Fork, have been designated as Scenic Streams by the Indiana Natural Resources Commission and as Outstanding State Resource Waters by the Indiana Water Pollution Control Board. Kokomo draws drinking water from Kokomo Reservoir, the largest impoundment in the watershed. Previous industrial activity in Kokomo has resulted in several severe pollution problems including a superfund site. Several of the streams in the watershed are impaired and on the Indiana 303(d) list.

Prior to IDEM’s initiative, the Indiana Department of Natural Resources (IDNR) maintained a Lake and River Enhancement project on the Wildcat Creek, Middle Fork, for three years. Soil and Water Conservation Districts, with technical assistance from the Natural Resources Conservation Service and educational assistance from the Purdue Cooperative Extension

Service, have implemented conservation practices on farms in the watershed for over fifty years. Despite these efforts, nonpoint source pollution problems still exist.

Wildcat Creek Watershed was chosen by IDEM to test the watershed approach to pollution abatement. Several urban centers, extensive agricultural activities, and the presence of streams which failed to meet designated uses presented a unique opportunity for a trial effort to integrate various IDEM programs with local and regional initiatives to implement watershed management practices.

This watershed has favorable characteristics for a state program since it is one of the smaller 8-digit hydrologic unit areas within the state. Goals for the project include:

- Develop an 'umbrella' plan for the watershed by June 1999. Plans for 11-digit and/or 14-digit watersheds will follow based on the amount of involvement of local residents.
- Develop Total Maximum Daily Loads (TMDLs) including monitoring and modeling for a portion of the Wildcat Creek Watershed by 1999 with implementation to follow shortly thereafter.
- Support local participation by providing information, technical assistance, and funding to locally led groups.
- Integrate within the agency the ability to 'think in watershed terms": to communicate, share data, enlist the aid of partner agencies to plan activities effectively in a watershed context.

IDEM will continue working with local groups and coordinating state and federal agency groups to restore stream reaches in the Wildcat Creek Watershed which are impaired, to provide integrated regulatory actions which are timed to meet existing watershed needs, and ultimately to provide residents of the watershed with waters which meet designated uses yet allow diverse land uses to continue.

Coordination with Other Agencies

The Indiana Department of Environmental Management has working relationships with other state and federal agencies interested in the improvement of Indiana water quality. In addition, results of projects completed by local and regional government, university and nonprofit organizations are integrated into reporting processes whenever possible.

The Natural Resources Conservation Service provides a liaison position within the IDEM Watershed Management Section. This person provides continuity between the two agency programs in the area of nonpoint source watershed management.

IDEM maintains a Memorandum of Understanding with the Indiana Department of Natural Resources and the Office of the Indiana State Chemist for managing ground water pesticide detections. The agencies are currently working on designing and implementing a statewide pesticide management plan. Well monitoring for pesticide contamination as part of this program has been undertaken with each state agency and the Indiana State Geological Survey providing needed assistance and expertise to determine the vulnerability to and any actual contamination of Indiana ground water by pesticides.

Activities in wetlands or other waters of the U.S. which may affect water quality are regulated under Clean Water Act Section 404. Activities require approval by IDEM through Clean Water Act Section 401 water quality certification programs. IDEM works cooperatively with two U.S. Army Corps of Engineers districts, the Indiana Department of Natural Resources, the U.S. fish and Wildlife Service and other agencies in administering the Clean Water Act Section 401 Water Quality Certification Program.

Cost/ Benefit Assessment

Actions necessary to achieve the objectives of the Clean Water Act create economic and social costs and benefits. It is recognized that information on these costs and benefits may be difficult to obtain due to the complexities of the economic analysis involved. However, until such time as comparable procedures for evaluating costs and benefits are in wider use, Indiana is providing as much of this information as possible.

Cost Information

The U. S. Bureau of the Census tracks expenditures for pollution control in the U.S. In 1994 $78,200,000 was spent in Indiana on pollution abatement for control of water pollution point sources. Of that amount $15,600,000 was spent for production process enhancements and $62,600,000 was spent for end of line treatment. In addition, $284,000,000 was spent in 1994 by manufacturing establishments with 20 or more employees for pollution abatement operating costs. Table 4 shows the number, location, and status of loans made in 1996 through the State Revolving Loan Fund (SRF) Program.

Table 4
Loans Supplied by the State Revolving Loan Fund 1996

Community	Date	Amount ($)	Status (September 1998)
City of Auburn	7/10/96	6,600,000	In construction
Town of Zanesville	7/10/95	2,345,000	Complete
Bass Lake C.D.	1/18/96	8,654,000	Complete
Town of Ashley	5/7/96	770,000	Complete
Town of Swayzee	5/7/96	1,300,000	Complete
Town of Ellettsville	8/12/96	9,425,000	Complete
City of Portage	12/16/96	10,000,000	In construction
East Chicago S. D.	12/27/96	14,000,000	In construction
Turkey Creek R.S.D.	3/19/97	3,915,000	Complete
Hammond S.D.	5/29/97	2,940,000	Complete
City of Attica	6/30/97	1,650,000	In construction

This program has grown significantly since 1996. Since July 1, 1997 thirty-five communities have closed on loans of over $174,700,000. This includes one drinking water loan project of $2,000,000. The program is expected to continue to grow over the next few years as recent changes in state regulations now make drinking water and nonpoint source projects eligible for SRF monies.

Benefits Information

Indiana water quality improvements result in enhanced recreational opportunities, more aquatic diversity, healthier sport fish populations, safe drinking water, increased use of beaches, and healthier aquatic ecosystems. Benefits of water pollution abatement and control have not been quantified in dollars in the past. With better accounting systems and direction through the Performance Partnership Agreement with U.S. EPA, the Office of Water Management hopes that resources to quantify the enormous benefits of water pollution abatement will be available in the future.

Special State Concerns and Recommendations

Fish consumption advisories have been issued for most of the streams and lakes in Indiana where fish tissue samples have been collected and analyzed. This information indicates that a large number of stream miles and lake acres are impaired by mercury and/or polychlorinated biphenyls (PCBs) resulting in bioaccumulation in tissue, consumption of which is a human health concern. The predominant causes for issuing fish consumption advisories in Indiana surface waters now appear to be mercury and PCBs. Although other chemicals may be present in fish tissue, the levels are such that human health is adequately protected by advisories based on mercury and PCB levels. Other chemicals present in water and sediment may cause water quality degradation, but the large number of miles/acres affected by mercury/PCB-caused fish consumption advisories overwhelms other causes of impairment and biases the list of causes/stressors for the state's waters.

This is an issue which is most apparent in the Great Lakes states where much of the fish tissue sampling and analysis has been done. In most instances where fish consumption advisories based on mercury and PCBs exist, no local sources of these substances have been identified. It is suspected that these pollutants may be present in many of the state's waters as a result of air deposition from atmospheric releases both near and far.

In order to identify sources of the contaminants and provide remedies, action is needed on a national level. U.S. EPA has agreed to take the lead in addressing mercury and PCB contamination in fish tissue. Fish consumption cause and source miles/acres should be separated from other aquatic life use cause and source miles/acres for Section 305(b) reporting so that causes which can be addressed at a state level will not be over shadowed by apparent high miles/acres of metals (mercury) and PCBs due to fish consumption advisories. States can then identify the predominant causes and sources of water quality prblems which can be addressed by state and local agencies.

SURFACE WATER ASSESSMENT

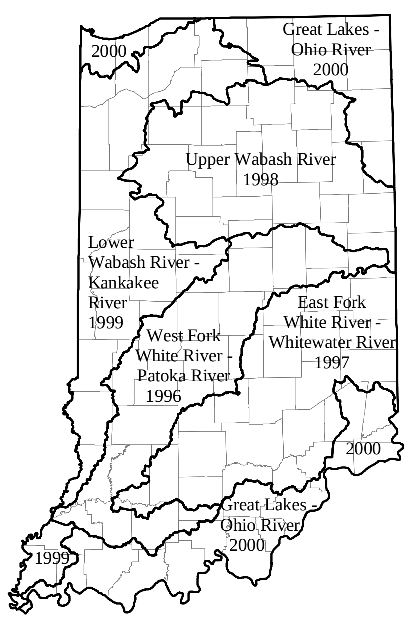
Current Surface Water Monitoring Program

The Office of Water Management designed a new surface water monitoring strategy in 1995 to assess the quality of Indiana waters within five years using a rotating basin approach. The monitoring strategy was revised and updated in 1998. The strategy is designed to provide technical data and information in support of the biennial Report of Indiana Water Quality (305[b] Report), National Pollutant Discharge Elimination System permitting program, and the annual Fish Consumption Advisory (issued by the Indiana State Department of Health in cooperation with IDEM and the Indiana Department of Natural Resources).

IDEM has adopted a rotating basin approach to monitor surface waters of the state (Figure 3). Approximately one-fifth of the state is scheduled for monitoring each year for five years. The monitoring results are analyzed and each waterbody is assessed in the second year. Waterbody impairments are generally reported in the third year. This report highlights the assessments for the first year of sampling completed in 1996. The current five year rotating basin monitoring plan for 1996 - 2000 is:

- 1996 White River Basin, West Fork, Basin and Patoka River Basin
- 1997 White River Basin, East Fork, Basin and Whitewater River Basin
- 1998 Upper Wabash River Basin
- 1999 Lower Wabash River Basin and Kankakee River Basin
- 2000 Great Lakes Basins and Ohio River Basin

Figure 3
Monitoring Strategy



The Office of Water Management's surface water quality monitoring strategy is designed to describe the overall environmental quality of each major river basin and to identify which waterbodies are impaired or do not meet water quality standards. The surface water monitoring strategy was revised this year to continue to meet the goal of assessing all waters of the state within five years while enhancing support of other Office of Water Management programs. Four goals of the monitoring program are:

1. Measure the physical, chemical, bacteriological, and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment.

2. Assess the impact of human or other activities that occur in all river basins and the probable effects of these activities on drinking water source protection and on the quality of the dynamic ecosystem.

3. Identify trends through analysis of environmental data from a variety of sources and make recommendations for the protection of designated uses of the water resources of the state.

4. Provide environmental quality assessment reports to support the water quality management program in partnership with customers and stakeholders.

The monitoring strategy encompasses various monitoring networks staffed by the Office of Water Management or managed by the Office of Water Management through contractors. Elements of the sampling program include: fixed station monitoring; sites selected by probabilistic design and sampled for fish community biotic integrity (IBI), benthic aquatic macroinvertebrate community biotic integrity (mIBI), fish tissue contaminants, surficial aquatic sediment contaminants, and water column chemistry; pesticide water column monitoring; bacteriological sampling; National Pollutant Discharge Elimination System permitting support; trace metals; total maximum daily load (TMDL) development; Wildcat Creek Watershed Initiative; White River monitoring in Marion County, Indiana; and targeted fish tissue and surficial aquatic sediment sites. A detailed description for each monitoring program may be found in the Assessment Branch fact sheets available from IDEM (1998b).

Quality Assurance Project Plans covering the major surface water sampling programs (Surface Water, Macroinvertebrates, Trace Metals) have been written and approved by U.S. EPA. Addenda to the Surface Water Quality Assurance Project Plan have been added for specific projects (i.e. pesticides) when applicable or necessary to include new or revised analytical methods.

The Office of Water Management follows a rigorous and well defined data quality objectives schedule for reviewing analytical results presented to the Assessment Branch. This allows the Assessment Branch staff to immediately categorize analytical results for appropriate use and to plan analytical requirements to meet the intended data use. There are four levels of Data Quality Objectives currently in use:

1 Screening data: The results are usually generated onsite, and have no QC checks. Analytical results which have no QC check sample results, no precision or accuracy information, no detection limit calculations, but just numbers, are included in this category.

2 **Project data:** Data are recorded in the field or laboratory on calibrated or standardized equipment. Field duplicates are measured on a regular periodic basis. Calculations may be done in the field or later at the office. Analytical results which have limited QC check samples are included in this category. Detection limits and ranges have been set for each analysis. The QC check sample information for field or laboratory results is useable for estimating precision, accuracy, and completeness for the project.

3 **Analytical data:** Analytical results include QC check samples for each batch of samples from which precision, accuracy, and completeness can be determined. Detection limits have been determined using 40 CFR Part 136 Appendix B, Revision 1.11. Raw data, chromatograms, spectrograms, bench sheets are not included in the report.

4 **CLP Laboratory and IDEM/BAA data:** Analytical results meet the U.S. EPA required Contract Laboratory Program (CLP) data analysis, contract required quantification limits (CRQL) and validation procedures. In the opinion of the reviewer results of analysis, validation and reporting are adequate to meet U.S. EPA CLP requirements. Additionally all reporting information required in the IDEM/Broad Agency Announcement and in the Surface Water QAPP Table 11-1 are included.

Data quality objective (DQO) level 1, screening, is used in the surface water program for presurveys and preliminary rapid assessment when precision and accuracy are not of concern. Most data received through grant projects and water column data received prior to 1996 are assigned DQO level 1. Stream and lake water quality assessment field measurements require DQO level 2 in order to assess compliance with water quality standards. Although most laboratory results are used for site and water body characterization and NPDES compliance sampling and compliance sampling inspection (CSI), requiring DQO level 3, the IDEM BAA requires all laboratories performing analyses for OWM to meet DQO level 4 with contract laboratory program (CLP) analytical and data validation procedures. Biological sample results used for fish consumption advisories meet DQO level 4. This gives OWM the flexibility to review data originally gathered for assessment or characterization purposes and to use the data in compliance actions. (IDEM 1996)

Plan for Achieving Comprehensive Assessments

IDEM adopted a new surface water quality monitoring strategy in 1995 with the goal of monitoring all waters of the state of Indiana by 2001. A five-year rotating basin plan was chosen which will result in reporting on assessment of all waters of the state by 2003. Each year approximately 20% of the state's surface water streams will be assessed and reported the next year using this process. Sampling began in the White River, West Fork, Watershed and the Patoka River Watershed in 1996. The data were analyzed and assessed in 1997. This is the first baseline report year for the rotating five-year assessments resulting from the new monitoring strategy. Approximately 16% of the area of the state is included in new assessments this year.

Public lake assessments are rotated on a five-year plan, generally north to south across the state. Assessments were rescheduled beginning with a new sampling rotation beginning in 1998. The new schedule more closely resembles the stream monitoring schedule. Since lake distribution is more dense in the northern area of the state, the schedules will not be an exact match. Lake monitoring results will generally be available at the end of each monitoring year. Lake assessments will generally be reported in the year following monitoring, one year ahead of stream assessments.

Ground water updates are provided as monitoring of Indiana hydrogeologic settings progresses each year. The hydrogeologic settings which are assessed are added to the groundwater report, and new assessments replace older assessments.

The five-year rotating basin approach will provide reports of comprehensive assessments of approximately 20% of Indiana watersheds each year. Surface waters will be assessed and reported for the entire state using this approach by 2002. A combination of probabilistic and targeted monitoring designs are used to provide data for waterbody assessment and to support other IDEM Office of Water Management goals and programs.

Assessment Methodology and Summary Data

Use support status was determined for each stream waterbody using the assessment guidelines provided by U.S. EPA (1997b). Results from four monitoring programs were integrated to provide an assessment for each stream waterbody reported here.

- Physical/chemical water column results.
- Benthic aquatic macroinvertebrate community assessments.
- Fish tissue and surficial aquatic sediment contaminant results.
- *E. coli* monitoring results.

Lake assessments were based on the Indiana Trophic State (or eutrophication) Index; a modified version of the BonHomme Index developed for Indiana lakes in 1972. This multi-metric index combines chemical, physical, and biological data into one overall trophic score for each public lake and reservoir sampled. Scores range from 0 to 75. Lower values reflect lower concentrations of nutrients. This information is useful in evaluating watershed impacts on a lake.

Indiana uses the U.S. EPA Waterbody System to record and track assessments on individual lakes, streams, and watersheds. This is the first year that Indiana submitted an electronic data file as part of the reporting process. While the software is not particularly useful for state agency planning, it is capable of recording and tracking assessment conclusions, providing continuity with the State 303(d) List, and identifying regulated drainage ways.

The Office of Water Management is in the process of reach indexing waterbodies which will allow geographic information system interface with the Waterbody System files to map assessment results. The mapping capabilities are expected to be extremely useful for watershed management and planning. This capability would be greatly enhanced if the Waterbody System were in a software program which allowed IDEM to add additional files to the database and to query the database with reporting capability.

Beginning this year waterbodies are being identified based on watershed areas known as 14- digit hydrologic unit areas (HUAs). These watersheds range from about 5,000 to 20,000 acres in Indiana. The average 14-digit hydrologic unit area in Indiana is about 12,000 acres or 20 square miles.

Large rivers with over 1,000 square miles of drainage area are tracked by reach of the mainstem within hydrologic unit areas. This way the wadeable streams and nonwadeable streams are separated so that issues, such as sampling techniques, which might bias results can be considered within a class of streams.

Lakes, reservoirs, and wetlands are tracked individually. They are reported with the hydrologic unit area in which they are located whether or not the lake or reservoir is separate, upstream, downstream, or within the mainstem of the hydrologic unit area.

Lake Michigan is tracked both as Great Lakes shoreline miles and as a lake with its own USGS cataloging unit (eight-digit hydrologic unit code). Tracking Lake Michigan as a separate lake waterbody is new this year, and will hopefully lead to better assessment and understanding of the water quality of the Indiana waters of this lake.

The assessment process was applied to each data sampling program. Then the individual assessments were integrated into an overall assessment for each waterbody by use designation: aquatic life support, fish consumption, recreational use. River miles in a watershed appear as one waterbody while each lake in a watershed is reported as a separate waterbody.

Physical/chemical data for toxicants (total recoverable metals), conventional water chemistry parameters (dissolved oxygen, pH, and temperature), and bacteria (*E. coli*) were evaluated for exceedance of the Indiana Water Quality Standards (327 IAC 2-1-6). U.S. EPA 305(b) Guidelines were applied to sample results as indicated in Table 5 (U.S. EPA 1997b).

Table 5
Criteria for Use Support Assessment

Parameter	**Fully Supporting**	**Partially Supporting**	**Not Supporting**
Aquatic Life Use Support			
Toxicants	Metals were evaluated on a site by site basis and judged according to magnitude of exceedance and the number of times exceedances occurred.		
Conventional inorganics	There were very few water quality violations, almost all of which were due to natural conditions.		
Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI)	mIBI $\geq$ 4.	mIBI < 4 and $\geq$ 2.	mIBI < 2.
Qualitative habitat use evaluation (QHEI)	QHEI $\geq$ 64.	QHEI < 64 and $\geq$ 51.	QHEI < 51.
Fish community (fIBI) (Lower White River only)	IBI $\geq$ 44.	IBI < 44 and $\geq$ 22	IBI < 22.

Table 5
Criteria for Use Support Assessment

Parameter	Fully Supporting	Partially Supporting	Not Supporting
Sediment (PAHs = polynuclear aromatic hydrocarbons. AVS/SEM = acid volatile sulfide/ simultaneously extracted metals.)	All PAHs ≤ 75th percentile. All AVS/SEMs ≤ 75th percentile. All other parameters ≤ 95th percentile.	PAHs or AVS/SEMs > 75th percentile. (Includes Grand Calumet River and Indiana Harbor Canal sediment results, and so is a conservative number.)	Parameters > 95th percentile as derived from IDEM Sediment Contaminants Database.
Indiana Trophic State Index (lakes only)	Nutrients, dissolved oxygen, turbidity, algal growth, and sometimes pH were evaluated on a lake-by-lake basis. Each parameter judged according to magnitude.		
Fish Consumption			
Fish tissue	No specific Advisory*	Limited Group 2 - 4 Advisory*	Group 5 Advisory*
* Indiana Fish Consumption Advisory, 1997, includes a state wide advisory for carp consumption. This was not included in individual waterbody reports because it obscures the magnitude of impairment caused by other parameters.			
Recreational Use Support (Swimmable)			
Bacteria (cfu = colony forming units.)	No more than one grab sample slightly > 235 cfu/100ml, and geometric mean not exceeded.	No samples in this classification.	One or more grab sample exceeded 235 cfu/100ml, and geometric mean exceeded.

List of Impaired Waters

Waterbodies which provide partial support or do not support their designated use are reported to U. S. EPA every two years as required by Section 303(d) of the Clean Water Act. IDEM Office of Water Management prepared and submitted to U.S. EPA the 1998 updated list of waters of the state which do not meet Clean Water Act goals.

The list was the result of technical review within the Office of Water Management and a public notice, meeting, and review process. Indiana public noticed the draft list and procedure in the February 1, 1998 Indiana Register and held three public meetings to allow the public to comment on the draft list and process. U.S. EPA Region V also commented on the draft list and process. Together, these comments provided additional information which influenced the content of the final 1998 303(d) list. The most recent copy of the list has been updated to clarify location and watershed nomenclature for several listed items. The list is presented in Table 6 or may be viewed on the IDEM internet site: (www.state.in.us/idem/owm/planbr/wqs/303d.htm)

Table 6
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Management 1998 303(d) List of Impaired Waterbodies*

1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
Lake Michigan Basin							
1	Beaver Dam Ditch	Crown Point	Lake	Impaired Biotic Communities	Medium	04040001	
2	Burns Ditch	Lake Station to Portage	Porter	FCA[1] for PCB[2] & Hg[3]; Pesticides; Lead; E. coli; Impaired Biotic Communities	High	04040001	
3	Crawford Ditch	Elkhart	Elkhart	Copper; Oil	Medium	04050001	
4	Crooked Lake	Burr Oak	Noble / Whitley	FCA for Hg	Low	04050001	
5	Deep River	Hobart	Lake	Impaired Biotic Communities	Medium	04040001	
6	Dunes Creek	Tremont	Porter	Impaired Biotic Communities	Medium	04040001	
7	Elkhart River	All	Elkhart	FCA for PCB & Hg; E. coli	Medium	04050001	
8	Grand Calumet River (East Branch)	Gary to East Chicago	Lake	FCA for PCB & Hg; Cyanide; Lead; Oil and Grease; Pesticides: Copper; Impaired Biotic Communities	High	04040001	1998-2000
9	Grand Calumet River (West Branch)	East Chicago to Hammond	Lake	FCA for PCB & Hg; Ammonia; D.O.[4]; Cyanide; Lead; Pesticides; Chlorides; Impaired Biotic Communities	High	04040001	1998-2000
10	Grand Calumet River Lagoons / Marquette Park Lagoon	Gary	Lake	FCA for PCB	Medium	04040001	1998-2000
11	Indiana Harbor Canal (IHC)	Whiting & East Chicago area	Lake	FCA for PCB & Hg; Pesticides; D.O.; Lead	High	04040001	1998-2000
12	Indiana Harbor Canal (Lake George Branch of)	East Chicago	Lake	FCA for PCB & Hg; D.O.; Oil and Grease; Pesticides; Impaired Biotic Communities	High	04040001	1998-2000
13	Jimmerson Lake	Nevada Mills	Steuben	FCA for Hg	Low	04050001	
14	Juday Creek	All	St. Joseph	FCA for PCB	Medium	04050001	
15	Lake George	Hobart	Lake	FCA for PCB	Medium	04040001	
16	Lake James	Crooked Lake	Steuben	FCA for Hg	Low	04050001	
17	Lake Michigan	Indiana portion	Lake / Porter / LaPorte	FCA for PCB & Hg; E.coli	High	04060200	
18	Lake Shipshewana	Shipshewana	Lagrange	FCA for PCB	Medium	04050001	
19	Lake Wabee	Milford	Kosciusko	FCA for Hg	Low	04050001	
20	Lake Wawasee	Syracuse	Kosciusko	FCA for PCB & Hg	Medium	04050001	
21	Little Calumet River	Porter to Chesterton	Porter	FCA for PCB & Hg; Cyanide; Pesticides; E. coli	High	04040001	
22	Little Calumet River	East of Chesterton	Porter / Laporte	FCA for PCB & Hg	Medium	04040001	
23	Little Calumet River	Hammond	Lake	FCA for PCB & Hg; Cyanide; Pesticides; Impaired Biotic Communities; D.O.	High	04040001	
24	Little Calumet River	Gary	Lake	FCA for PCB & Hg; Cyanide; Pesticides; Impaired Biotic Communities	High	04040001	
25	Long Lake	Pleasant Lake	Steuben	FCA for Hg	Low	04050001	
26	Marsh Lake	Fremont	Steuben	FCA for Hg	Low	04050001	
27	Mather's Ditch	Middlebury	Elkhart	D.O.; Endrin	Medium	04050001	
28	Mud Creek	Angola	Steuben	Ammonia, D.O.	Medium	04050001	
29	Niles Ditch	Crown Point	Lake	Impaired Biotic Communities	Medium	04040001	
30	Olin Lake	Valentine	Lagrange	FCA for Hg	High	04050001	
31	Oliver Lake	Valentine	Lagrange	FCA for Hg	Low	04050001	
32	Orland Tributary	Orland	Steuben	D.O.	Medium	04050001	
33	Pigeon Creek	All	Steuben	FCA for PCB & Hg	Medium	04050001	

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1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
34	Salt Creek	Portage / Valparaiso	Porter	E. coli	Low	04040001	
35	Snow Lake	Jamestown	Steuben	FCA for Hg & PCB	Medium	04050001	
36	St. Joseph River	All	St. Joseph / Elkhart	FCA for PCB & Hg; E. coli	High	04050001	
37	Trail Creek	Michigan City	LaPorte	FCA for PCB & Hg; Cyanide; E. coli	Medium	04040001	
38	Turkey Creek	Hobart	Lake	Impaired Biotic Communities	Medium	04040001	
39	Wolf Lake	Indiana portion	Lake	FCA for PCB	Medium	04040001	
Maumee River Basin							
40	Blue Creek	All	Adams	D.O.	Medium	04100004	
41	Cedar Creek	Cedarville	Allen / DeKalb	E. coli	Low	04100003	
42	Garrett City Ditch	Garrett	DeKalb	Ammonia	Medium	04100003	
43	Habegger Ditch	Berne	Adams	Ammonia	Medium	04100004	
44	Hamilton Lake	Hamilton	Steuben	FCA for Hg	Low	04100003	
45	Maumee River	All	Allen	FCA for PCB & Hg	Medium	04100005	
46	St. Joseph River	All	Allen	FCA for PCB & Hg	High	04100003	
47	St. Mary's River	All	Allen	FCA PCB & Hg	Medium	04100004	
48	Swartz-Carnahan Ditch	Hursh	Allen	D.O.	Medium	04100003	
49	Tiernan Ditch	Ft. Wayne	Allen	D.O.	Medium	04100003	
Kankakee River Basin							
50	Beaver Creek	Morocco	Newton	Impaired Biotic Communities	Medium	07120002	
51	Cedar Creek	Lowell	Lake	Impaired Biotic Communities	Medium	07120001	
52	Cedar Lake	Cedar Lake	Lake	FCA for PCB	Medium	07120001	
53	Cobb Creek / Breyfogel Ditch	Hebron	Porter	D.O.; Impaired Biotic Communities	Medium	07120001	
54	Crooked Creek	Westville / Valparaiso	LaPorte / Porter	Impaired Biotic Communities	Medium	07120001	
55	Dyer Ditch	Dyer	Lake	Impaired Biotic Communities	Medium	07120003	
56	Iroquois River	All	Jasper / Newton	FCA for PCB	Medium	07120002	
57	Kankakee River	All	Lake / LaPorte	FCA for PCB & Hg; E. coli	Medium	07120001	
58	Pine Creek	North Judson	Starke	D.O.	Medium	07120001	
59	Unnamed Ditch	Wyatt	St. Joseph	E.coli	High	07120001	
Wabash River Basin							
60	Big Pine Creek	All	Warren	FCA for PCB & Hg	Medium	05120108	
61	Big Raccoon Creek	Above Mansfield Reservoir	Putnam	Impaired Biotic Communities	Medium	05120108	
62	Big Raccoon Creek	All	Parke	FCA for PCB & Hg	Medium	05120108	
63	Center Lake	Warsaw	Kosciusko	FCA for PCB	Medium	05120106	
64	Cornstalk Creek	All	Putnam	Impaired Biotic Communities	Medium	05120108	
65	Deer Creek	All	Carroll	FCA for PCB & Hg	Medium	05120105	
66	Dugger Lake	Dugger	Sullivan	FCA for PCB	Medium	05120111	
67	Eel River	Counties Listed	Whitley / Miami	FCA for PCB & Hg	Medium	05140104	
68	Eel River	Roann	Wasbash / Miami	Cyanide	Medium	05140104	
69	Eel River	Cass County	Cass	FCA for Hg	Low	05140104	

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1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
70	Eel River	Wabash County	Wasbash	FCA for PCB	Medium	05140104	
71	Elliot Ditch	Lafayette	Tippecanoe	FCA for PCB	High	05120108	
72	Kokomo Creek	Kokomo	Howard	FCA for PCB; Ammonia; D.O.	High	05120107	1998-2000
73	Kokomo Reservoir #2	Kokomo	Howard	FCA for Hg	Low	05120107	
74	Lake Manitou	Rochester	Fulton	FCA for Hg	Low	05120106	
75	Lake Maxinkuckee	Culver	Marshall	FCA for Hg	Low	05120106	
76	Little Mississinewa River	Union City	Randolph	FCA for PCB	High	05120103	
77	Little Sugar Creek	Crawfordsville	Montgomery	FCA for PCB & Hg	High	05120110	
78	Little Wildcat Creek/Kelly West Ditch	Kokomo	Howard	D.O.	Medium	05120107	1998-2000
79	Mississinewa River	All	Randolph / Delaware / Grant	FCA for PCB & Hg	High	05120103	
80	North Ramp Creek	All	Putnam	Impaired Biotic Communities	Medium	05120108	
81	Otter Creek	Terre Haute	Vigo	FCA for PCB & Hg	Medium	05120111	
82	Pike Lake	Warsaw	Kosciusko	FCA for Hg	Medium	05120106	
83	Prairie Creek Ditch	Kokomo	Howard	D.O.	Medium	05120107	1998-2000
84	South Fork Wildcat Creek	Frankfort	Clinton	Cyanide	High	05120107	1998-2000
85	South Ramp Creek	All	Putnam	Impaired Biotic Communities	Medium	05120108	
86	Sugar Creek	Terre Haute	Vigo	Impaired Biotic Communities	Medium	05120111	
87	Sugar Creek	All	Montgomery	FCA for PCB & Hg	High	05120110	
88	Sugar Creek	All	Parke	FCA for PCB	Medium	05120110	
89	Sulphur Creek	Hymera	Sullivan	Impaired Biotic Communities	Medium	05120111	
90	Tippecanoe Lake	Oswego	Kosciusko	FCA for Hg	Low	05120106	
91	Tippecanoe River	Rochester	Fulton	Cyanide	High	05120106	
92	Tippecanoe River	All	Kosciusko / Fulton / Pulaski	FCA for PCB & Hg	Medium	05120106	
93	Wabash River	Counties Listed	Wells / Huntington / Wabash / Miami / Cass / Carroll / Tippecanoe / Vigo / Sullivan Knox / Gibson / Posey	FCA for PCB & Hg	High	051201	
94	Wabash River	Counties Listed	Fountain / Vermillian	FCA for PCB	High	051201	
95	Wabash River	Andrews	Huntington	Cyanide	High	05120101	
96	Wea Creek	Lafayette	Tippecanoe	FCA for PCB	High	05120108	
97	Wildcat Creek	Kokomo	Howard / Carroll / Tippecanoe	FCA for PCB; Ammonia; D.O.;Cyanide; Lead; Nitrates	High	05120107	1998-2000
98	Winona Lake	Warsaw	Kosciusko	FCA for PCB	Medium	05120106	
White River Basin							
99	Bean Creek	Indianapolis	Marion	E. coli	High	05120201	

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1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
100	Beanblossom Creek	All	Brown / Monroe	E.coli	Low	05120202	
101	Big Walnut Creek	Putnam Co. Line to Eel River	Putnam	FCA for Hg	Low	05120203	
102	Buck Creek	All	Delaware	FCA for PCB & Hg; Impaired Biotic Communities	Medium	05120201	
103	Cataract Lake / Cagles Mill Lake	All	Putnam	FCA for Hg	Low	05120203	
104	Cicero Creek	Downstream of Morse Reservoir(196th. St.)	Hamilton	E.coli	Low	05120201	
105	Conneley Ditch	All	Clay	E.coli	Low	05120203	
106	Dollar Hide Creek	All	Marion	Impaired Biotic Communities	Medium	05120201	
107	Duck Creek	Elwood to S.R. 213	Madison / Tipton / Hamilton	E.coli	Low	05120201	
108	E.F. White Lick Creek	Headwaters to U.S. 40	Marion / Hendricks	Impaired Biotic Communities	Medium	05120201	
109	E.F. White Lick Creek	All	Hendricks	FCA for PCB	Medium	05120201	
110	Eagle Creek	Indianapolis	Marion / Boone	E. coli	High	05120201	
111	East Fork Fish Creek	Downstream of Vandalia	Owen	Impaired Biotic Communities	Medium	05120202	
112	Eel River	Brunswick to West Fork White River	Clay / Greene	E.coli	Low	05120203	
113	Eel River	From Splunge Creek to West Fork White River	Greene	FCA for PCB & Hg	Medium	05120203	
114	Fall Creek	All	Madison / Hamilton	FCA for PCB & Hg	Medium	05120201	
115	Fall Creek	Emerson Ave. in Indpls to West Fork White River	Marion	E.coli	High	05120201	1998-2000
116	First Creek	All	Greene Daviess Martin	E.coli	Low	05120202	
117	Geist Reservoir	All	Hamilton / Marion	FCA for Hg	Low	05120201	
118	Hawkins Creek	All	Daviess	Impaired Biotic Communities	Medium	05120208	
119	Honey Creek	All	Johnson	Impaired Biotic Communities	Medium	05120201	
120	Indian Creek	All	Morgan	E.coli	Low	05120201	
121	Indianapolis Waterway Canal	Indianapolis	Marion	E. coli	High	05120201	
122	Jacks Defeat Creek	All	Monroe	Impaired Biotic Communities	Medium	05120202	
123	Jones Creek	All	Putnam	Impaired Biotic Communities	Medium	05120203	
124	Kessinger Ditch	All	Knox	E.coli	Low	05120202	
125	Killbuck Creek	All	Madison	FCA for PCB & Hg; E. coli	Medium	05120201	
126	Lake Lemon	All	Monroe	FCA for PCB	Medium	05120202	
127	Lambs Creek	All	Morgan	E.coli	Low	05120201	

Table 6
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Management 1998 303(d) List of Impaired Waterbodies*

1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
128	Lick Creek	All	Greene / Owen	E.coli	Low	05120203	
129	Little Cicero Creek	All	Hamilton	Impaired Biotic Communities	Medium	05120201	
130	Little Deer Creek	All	Putnam	Impaired Biotic Communities	Medium	05120203	
131	Maiden Run	All	Putnam	Impaired Biotic Communities	Medium	05120203	
132	Mars Ditch	All	Marion	Cyanide; pH	High	05120201	
133	McCormick's Creek	All	Monroe / Owen	Impaired Biotic Communities	Medium	05120202	
134	Mill Creek	Upstream of U.S. 40	Hendricks	E.coli	Low	05120203	
135	Morse Reservoir	All	Hamilton	FCA for Hg	Low	05120201	
136	Pipe Creek	All	Madison	FCA for PCB & Hg; E.coli	Medium	05120201	
137	Pleasant Run	All	Marion	E.coli	High	05120201	1998-2000
138	Plum Creek	All	Putnam	Impaired Biotic Communities	Medium	05120203	
139	Plummer Creek	All	Greene	E.coli	Low	05120202	
140	Pogues Run	Indianapolis	Marion	E. coli	High	05120201	
141	Prairie Creek (North & South Forks)	All	Daviess	E. coli	Low	05120202	
142	Richland Creek	All	Monroe / Owen	FCA for PCB & Hg; E. coli; Impaired Biotic Communities	Medium	05120202	
143	South Fork Griffy Creek	All	Monroe	Impaired Biotic Communities	Medium	05120202	
144	State Ditch	All	Marion	Cyanide; pH; E. coli	High	05120201	
145	Stoney Creek	Noblesville	Hamilton	FCA for PCB; E.coli	High	05120201	
146	Stout Creek	All	Monroe	FCA for PCB & Hg	Medium	05120208	
147	Wabash and Erie Canal	Clay County	Clay	E.coli	Low	05120203	
148	West Fork White River	Fall Creek To Pleasant Run	Marion	FCA for PCB & Hg; E.coli; D.O.; Ammonia	High	05120201	
149	West Fork White River	Indianapolis from Pleasant Run to Little Buck Creek	Marion	FCA for PCB & Hg; Cyanide; D.O.; E. coli; Impaired Biotic Communities	High	05120201	
150	West Fork White River	Crooked Creek to Fall Creek	Marion	FCA for PCB & Hg	High	05120201	
151	West Fork White River	Cicero Creek to Crooked Creek	Hamilton / Marion	FCA for PCB & Hg; Impaired Biotic Communities	High	05120201	
152	West Fork White River	White Lick Cr. to Beanblossom Cr.	Morgan / Monroe	FCA for PCB & Hg; Cyanide; E. coli; Impaired Biotic Communities	Medium	05120201	
153	West Fork White River	Hamilton County	Hamilton	FCA for PCB & Hg; E. coli; Impaired Biotic Communities	High	05120201	
154	West Fork White River	Little Buck Creek to White Lick Creek	Marion / Johnson / Morgan	FCA for PCB & Hg; Cyanide; E. coli; Impaired Biotic Communities	High	05120201	
155	West Fork White River	Beanblossom Cr. to Buckhall Cr.	Monroe / Owen / Greene	FCA for PCB & Hg; Cyanide; E. coli; Impaired Biotic Communities	Medium	05120202	
156	West Fork White River	Richland Cr. to Black Cr.	Greene / Daviess / Knox	FCA for PCB & Hg; Impaired Biotic Communities	Medium	05120202	
157	West Fork White River	Madison County	Madison	FCA for PCB; E. coli; Impaired Biotic Communities	Medium	05120201	

Table 6
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Management 1998 303(d) List of Impaired Waterbodies*

1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
158	West Fork White River	Muncie to Madison County	Delaware	FCA for PCB & Hg; E.coli	Medium	05120201	
159	West Fork White River	All	Greene / Owen	FCA for PCB & Hg	Medium	05120202	
160	West Fork White River	Elnora to Maysville	Daviess / Knox	FCA for PCB and Hg; Lead; Impaired Biotic Communities	Medium	05120202	
161	West Fork White River	Maysville to East Fork White River	Daviess / Knox	FCA for PCB & Hg; Impaired Biotic Communities	Medium	05120202	
162	West Fork White River	Headwaters to Muncie	Randolph/ Delaware	FCA for PCB & Hg; Impaired Biotic Communities	Medium	05120201	
163	White Lick Creek	All	Hendricks / Morgan	FCA for PCB & Hg	Medium	05120201	
164	Big Blue River	All	Henry / Rush / Shelby / Johnson	FCA for PCB; Cyanide	Medium	05120204	
165	Brandywine Creek	All	Hancock	FCA for Hg	Low	05140104	
166	Clear Creek	All	Monroe	FCA for PCB; E. coli; Impaired Biotic Communities	High	05120108	
167	Dogwood Lake	Alfordsville	Daviess	FCA for Hg	Low	05120208	
168	East Fork Jackson Creek	All	Monroe	Impaired Biotic Communities	Medium	05120208	
169	East Fork White River	All	Jackson / Lawrence	FCA for PCB & Hg	High	05120108	
170	East Fork White River	All	Bartholomew / Martin	FCA for PCB	Medium	05120206	
171	Flat Rock River	All	Rush	FCA for Hg	Low	05120205	
172	Flat Rock River	All	Shelby	FCA for PCB & Hg	Medium	05120205	
173	Jackson Creek	All	Monroe	Impaired Biotic Communities	Medium	05120208	
174	Little Blue River	All	Shelby	FCA for PCB	Medium	05120204	
175	Little Sugar Creek	All	Hancock	FCA for PCB & Hg	Medium	05120204	
176	Monroe Reservoir	All	Monroe	FCA for Hg	Low	05120208	
177	Muddy Fork of Sand Creek	All	Decatur	FCA for PCB & Hg	Medium	05120206	
178	Muscatatuck River	All	Washington	FCA for PCB & Hg	Medium	05120207	
179	Pleasant Run	All	Lawrence	FCA for PCB	High	05120208	
180	Salt Creek	All	Lawrence	FCA for PCB & Hg	High	05120208	
181	Sand Creek	All	Decatur	FCA for PCB & Hg	Medium	05120206	
182	Sand Creek	All	Jennings	FCA for Hg	Low	05120206	
183	Sugar Creek	All	Hancock	FCA for Hg	Low	05120204	
184	Sugar Creek	All	Johnson	FCA for PCB	Medium	05120204	
185	West Fork Clear Creek	All	Monroe	Impaired Biotic Communities	Medium	05120208	
186	Yellowwood Lake	All	Brown	FCA for Hg	Low	05120208	
187	Young's Creek	All	Johnson	FCA for PCB	Medium	05120204	
188	White River	From the confluence of West Fork White River and East Fork White River to Wabash River	Pike / Gibson / Knox	FCA for PCB & Hg; Impaired Biotic Communities	Medium	05120202	

Table 6
INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Office of Water Management 1998 303(d) List of Impaired Waterbodies*

1998 303(d) Number	Water Body	Location Reach	County	Parameter(s) of Concern	Severity Ranking	HUC	Date Targeted
Great Miami River Basin							
189	Brookville Reservoir	Brookville	Franklin	FCA for Hg	Low	05080003	
190	East Fork Whitewater River	All	Wayne	FCA for PCB	Medium	05080003	
191	Great Miami River	All	Dearborn	FCA for PCB & Hg	High	05080002	
192	West Fork Whitewater River	All	Fayette	FCA for PCB & Hg	Medium	05080003	
193	Whitewater River	All	Dearborn	FCA for PCB & Hg	Medium	05080003	
194	Middle Fork Reservoir	Richmond / Middleboro	Wayne	FCA for Hg	Low	05080003	
Patoka River Basin							
195	Patoka Reservoir	Ellsworth	Orange / Crawford / Dubois	FCA for Hg	Low	05120209	
196	Patoka River	Downstream of Patoka Reservoir	Dubois; Pike; Gibson	FCA for PCB & Hg	Medium	05120209	
197	South Fork Patoka River	All	Pike	Impaired Biotic Communities	High	05120209	
Ohio River Basin							
198	Bischoff Reservoir	Batesville	Ripley	FCA for Hg	Low	05090203	
199	Blue River	All	Harrison	FCA for PCB & Hg	Medium	05140104	
200	Cypress Creek	Booneville	Warrick	Chlordane	Medium	05140202	
201	Deam Lake	New Providence	Clark	FCA for Hg	Low	05140101	
202	Little Pigeon Creek	Dale	Spencer	D.O., Ammonia	Medium	05140201	
203	Ohio River	New Albany, Jeffersonville	Clark / Floyd	FCA for PCB; Lead; E. coli	Medium	05	
204	Ohio River	Evansville		FCA for PCB; Lead; E. coli	Medium	05	
205	Ohio River	Entire Length adjacent to Indiana	Dearborn Ohio Switzerland Jefferson Clark Floyd Harrison Crawford Perry Spencer Warrick Vanderburg Posey	FCA for PCB; E. coli	Medium	05090203 05140101 05140104 05140201 05140202	
206	Pigeon Creek	Evansville	Vanderburg h	FCA for PCB; Organics; Chlordane	High	05140202	
207	Silver Creek	New Albany	Floyd	FCA for PCB & Hg	Medium	05140101	
208	Versailles Lake	Versailles	Ripley	FCA for Hg	Low	05090203	

[1]FCA - Fish Consumption Advisory
[2]PCB - Polychlorinated Biphenyls
[3]Hg - Mercury
[4]D.O. - Dissolved Oxygen

*Only waters for which fish tissue data support issuance of fish consumption advisories are individually cited above. The Indiana Department of Health has issued a general fish consumption advisory for all other waters of the state. This advisory was based on extrapolation of the fish tissue data that were available and generally recommends that if no site-specific advisory is in place for a waterbody, the public should eat no more than one meal (8 oz.) per week of fish caught in these waters. Women of child bearing age, women who are breast feeding, and children up to 15 years of age should eat no more than one meal per month. The basis for this general advisory is widespread occurrence of mercury or PCBs (or both) in most fish sampled throughout the state. Please refer to the most recent Fish Consumption Advisory booklet available through the Indiana Department of Health (317/233-7808). Sources of the mercury and PCBs are unknown for the most part, but it is suspected that they result from air deposition in many cases. This could mean that the sources are located outside state and national boundaries. Assessment and control of these pollutants may therefore require interstate and international measures which are beyond the scope of state environmental agencies. These waters have low priority for TMDL development. (Indiana Department of Environmental Management, 1998a).

Rivers and Streams Water Quality Assessment

Designated Use Support

Rivers and streams in four watersheds were assessed for support of uses designated in Indiana water quality standards (Indiana Legislative Services Agency, 1997). The standards have both narrative and numeric requirements which are used to evaluate designated use support. Indiana has several designated uses for surface water. The ability of waterbodies to support aquatic life use and recreational use were assessed for this report. Refer to Part 2 for Individual waterbody assessment results.

In addition, fish consumption advisories use data resulting from the bioaccumulation of pollutants in fish tissues. Fish consumption advisories are tracked separately from other aquatic life use support parameters as provided in U.S. EPA guidance (U.S. EPA 1997b).

In addition to the use support criteria described in the Assessment Methodology Section, page 17 of this report, summary information has been determined by aggregating individual waterbody assessment mileage for those waterbodies which were assessed for this report. Threatened waters currently meet state water quality standards, but show a trend or conditions which, if the trend continues or the condition worsens may result in the waterbody being impaired. Impaired waterbodies either partially support designated uses or do not support designated uses.

Assessed waters are those waterbodies which were evaluated or monitored and classified for use support based on the monitoring results. Evaluated waterbodies would have had monitoring data over five years old. Monitored waterbodies have monitoring data five or less years old. Most waterbodies reported this year were monitored in 1996 with some supplemental monitoring data from samples collected as early as 1987 for some waterbodies (U. S. EPA 1997a). Table 7 summarizes the use support assigned to each stream mile assessed for this report.

Table 7
Summary of Fully Supporting, Threatened and Impaired Waters

Waterbody Type: Rivers (All size units are to the nearest ten Miles)

Degree of Use Support	Assessment Basis: Evaluated	Assessment Basis: Monitored	Total Assessed Size
Size Fully Supporting All Assessed Uses	0	3970	3970
Size Fully Supporting All Assessed Uses but Threatened for At Least One Use	0	430	430
Size Impaired for One or More Uses	0	4000	4000
Size Not Attainable for Any Use and Not Included in the Line Items Above	0	0	0
TOTAL ASSESSED	0	8400	8400

Source: Calculated from Indiana Waterbody System Data.

Waterbodies are classified for support of designated uses as described in the Assessment Methodology Section, page 17. Individual use support for the state is determined by adding the stream miles within each individual use for all waterbodies assessed. Indiana recreational use support is identified by US EPA as “swimmable”, and the terms are used interchangeably in this report. Table 8 summarizes how many total stream miles throughout the state are in each support category for the approximately 16% of the Indiana stream miles monitored in 1996 and assessed for this report. The table indicates "Supporting" miles meet Clean Water Act goals. "Supporting but Threatened" miles meet Clean Water Act goals, but exhibit signs of deterioration which if not addressed might result in impairment at some future time. "Partially Supporting" miles, while impaired to some extent also support the designated use part of the time or in part of the waterbody. Fish consumption advisory for a subpopulation is an example of this category. "Not Supporting" miles clearly violate one or more of Indiana numeric water quality standards (predictive) or exhibit conditions which do not support the narrative water quality standards (responsive). Indiana currently has 77 stream miles classified as "Not Attainable" which were not included in assessments for this report. Since this is the first year of reporting under the new monitoring strategy the number of miles in the "Not Assessed" column represents miles of streams or rivers which will be assessed over the next four years.

Table 8
Individual Use Support Summary

Waterbody Type: River (All size units are in Miles)

Use	Supporting	Supporting but Threatened	Partially Supporting	Not Supporting	Not Attainable	Not Assessed
AQUATIC LIFE SUPPORT	5392.00	418.70	719.90	807.90		28334.50
FISH CONSUMPTION			2550.96	478.10		32643.94
SHELLFISHING						
SWIMMABLE	3147.10	59.80	178.80	690.20		31597.10
DRINKING WATER SUPPLY						
AGRICULTURE						

Source: Indiana Waterbody System and U.S. EPA River Reach File 3.

Causes/Stressors and Sources of Impairment of Designated Uses

Causes/ stressors are those pollutants or other stressors that contribute to the actual or threatened impairment of designated uses in a waterbody. Toxic substances listed in the state water quality numeric standards and conditions such as habitat alterations, presence of exotic species, etc. are all examples of causes or stressors. The stressor inhibits the waterbody from providing a habitat which can support aquatic life or creates a situation that is hazardous to human health or animal life.

Table 9 represents the total miles of streams affected by each cause/stressor in Indiana. A waterbody may be impaired by several different causes/stressors so that the total stream miles affected may actually be less than the total number of miles listed in the table.

Major impacts include waters with acute criteria violations of state water quality standards for toxic substances or ammonia; a group 5 (do not eat any fish) fish consumption advisory for PCBs or mercury; scores of very poor or less based on biological assessments; and waters that exceed the *E. coli* criterion and are used or potentially used extensively for whole body contact recreation where potential sources of *E. coli* are identifiable. The moderate/minor impact column includes chronic criteria violations of state water quality standards for toxic substances, ammonia or dissolved oxygen; violations of state water quality standards for pH, chlorides, etc.; waters threatened or scoring "poor" on biological assessments; waters which had group 2,3 or 4 fish consumption advisories for mercury or PCBs; and waters with *E. coli* violations that have limited potential for whole body contact recreation.

Table 9
Total Sizes of Waters Impaired by Various Causes/ Stressor Categories

Sizes of Waterbodies Not Fully Supporting Uses Affected by Various Cause Categories

Waterbody Type: River (All sizes are in Miles)

Cause Categories	Major Impact	Moderate/Minor Impact
0000 CAUSE UNKNOWN	0.00	443.80
0200 PESTICIDES	0.00	69.91
0300 PRIORITY ORGANICS	0.00	114.70
0410 PCBs	953.30	1961.50
0500 METALS	141.00	2257.30
0600 AMMONIA (UNIONIZED)	0.00	104.70
0720 CYANIDE	0.00	328.20
0800 OTHER INORGANICS	0.00	70.20
1200 ORGANIC ENRICHMENT/LOW DO	0.00	169.30
1300 SALINITY/TDS/CHLORIDES	0.00	3.00
1600 HABITAT ALTER. (non-flow)	0.00	109.30
1700 PATHOGENS	0.00	877.00
1900 OIL AND GREASE	0.00	11.80

Sources are the activities that contribute pollutants or stressors to surface water resulting in impairment of designated uses in a waterbody. The activities listed in Table 10 represent the total stream miles impaired due to each type of source. The major and moderate/minor impact columns generally relate to the relative impact of the cause from the previous table.

Table 10
Total Sizes of Waters Impaired by Various Source Categories

Sizes of Waterbodies Not Fully Supporting Uses Affected by Various Source Categories

Waterbody Type: River (All sizes are in Miles)

Source Categories	Major Impact	Moderate/Minor Impact
0400 COMBINED SEWER OVERFLOW	0.00	21.20
5000 RESOURCE EXTRACTION	39.00	0.00
6000 LAND DISPOSAL	0.00	33.50
9000 SOURCE UNKNOWN	82.00	3703.40

Lake Water Quality Assessment

Designated Use Support

The ability of inland lakes and reservoirs to support aquatic life was assessed using data collected for the Indiana Trophic State Index (TSI); a multi-metric measurement of the eutrophication (or nutrient enrichment) levels in lakes. These data include various forms of nitrogen and phosphorous, dissolved oxygen, water clarity, and plankton. As with rivers and streams, fish consumption was evaluated via the state's 1998 advisory. Swimmable uses of lakes are typically not assessed, since *E. coli* is not routinely sampled in the Indiana Lakes Program. Swimmability may have been assessed, though, if bacteria levels at a public beach were, in fact, being monitored and the information made available to IDEM. Lakes were considered suitable for agricultural uses as long as there was no evidence of gross violation of the state's minimum water quality standards.

Although IDEM is not actively monitoring parameters of interest to drinking water providers, lakes used as such are identified in the "Not Assessed" category below. Among other efforts to be made in the future is that of gathering and reporting the monitoring results of those providers who do assess the quality of their raw water sources, or possibly expanding Indiana's current monitoring program to include other key parameters.

The two waterbody types addressed here are:
- Great Lakes Shoreline - the near shore area of Lake Michigan as reported previously (Table 11a).
- Lakes, Reservoirs - publicly-owned lakes and reservoirs, and all impoundments within stream channels which are tracked separately from the rivers and streams themselves (Table 11b).

Table 11 (a and b)
Summary of Fully Supporting, Threatened and Impaired Lakes and Reservoirs

Table 11a. Waterbody Type: Great Lakes Shoreline (units = miles of shoreline)

Degree of Use Support	Assessment Basis Evaluated	Assessment Basis Monitored	Total Assessed Size
Size Fully Supporting All Assessed Uses	0.00	0.00	0.00
Size Fully Supporting All Assessed Uses but Threatened for At Least One Use	0.00	0.00	0.00
Size Impaired for One or More Uses	0.00	43.00	43.00
Size Not Attainable for Any Use and Not Included in the Line Items Above	0.00	0.00	0.00
TOTAL ASSESSED	0.00	43.00	43.00

Table 11b. Waterbody Type: Lake, Reservoir (units = size in acres)

Degree of Use Support	Assessment Basis Evaluated	Assessment Basis Monitored	Total Assessed Size
Size Fully Supporting All Assessed Uses	0.00	0.00	0.00
Size Fully Supporting All Assessed Uses but Threatened for At Least One Use	0.00	0.00	0.00
Size Impaired for One or More Uses	0.00	45135.00	45135.00
Size Not Attainable for Any Use and Not Included in the Line Items Above	0.00	0.00	0.00
TOTAL ASSESSED	0.00	45135.00	45135.00

Lakes are classified for support of designated uses as described in the Assessment Methodology discussion beginning on page 17. Individual use support for lakes is determined by adding the acres of support, partial support, or nonsupport for each lake assessed. All of Indiana's portion of the Lake Michigan shoreline and about 45,000 inland lake acres were assessed for this report (Table 12 [a and b]).

Table 12 (a and b)
Individual Use Support Summary

Table 12a. Waterbody Type: Great Lakes Shoreline (units = miles of shoreline)

Use	Supporting	Supporting but Threatened	Partially Supporting	Not Supporting	Not Attainable	Not Assessed
AQUATIC LIFE SUPPORT	43.00					
FISH CONSUMPTION			43.00			
SWIMMABLE			43.00			
DRINKING WATER SUPPLY						
AGRICULTURE						

Table 12b. Waterbody Type: Lake, Reservoir (units = size in acres)

Use	Supporting	Supporting but Threatened	Partially Supporting	Not Supporting	Not Attainable	Not Assessed
AQUATIC LIFE SUPPORT	6725.00	6730.00				92745.00
FISH CONSUMPTION			43178.00	1957.00		61065.00
SWIMMABLE						106200.00
DRINKING WATER SUPPLY						12055.00
AGRICULTURE	13455.00					92745.00

Causes/ stressors are those pollutants or other stressers that contribute to the actual impairment of designated uses in a lake. A stressor may inhibit the lake from providing an environment suitable for aquatic life or may create a situation that is hazardous to human health or animal life. Table 13(a and b) represents the total lake acres affected by each cause/ stressor.

Table 13 (a and b)
Total Sizes of Waters Impaired by Various Causes/Stressor Categories

Table 13a. Waterbody Type: Great Lakes Shoreline (units = miles of shoreline)

Cause Categories	Major Impact	Moderate/Minor Impact
0410 PCBs	0.00	43.00
0500 METALS	0.00	43.00
1700 PATHOGENS	0.00	43.00

Table 13b. Waterbody Type: Lake, Reservoir (units = size in acres)

Cause Categories	Major Impact	Moderate/Minor Impact
0410 PCBs	1155.00	4876.00
0500 METALS	802.00	42336.00
1200 ORGANIC ENRICHMENT/LOW DO	0.00	4440.00

Sources are the activities that contribute pollutants or stressors to lakes resulting in impairment of designated uses in the lake. Activities which cause pollution or stress to Indiana lakes are unknown at this time (Table 14 [a and b]).

Table 14 (a and b)
Total Sizes of Waters Impaired by Various Source Categories

Table 14a. Waterbody Type: Great Lakes Shoreline (units = miles of shoreline)

Source Categories	Major Impact	Moderate/Minor Impact
9000 SOURCE UNKNOWN	0.00	43.00

Table 14b. Waterbody Type: Lake, Reservoir (units = size in acres)

Source Categories	Major Impact	Moderate/Minor Impact
9000 SOURCE UNKNOWN	802.00	44333.00

Clean Lakes Program

The Indiana Clean Lakes Program monitored the water quality of 164 lakes during the summer months of 1996 and 1997. (The individual assessments for these are still being entered into EPA's Waterbody System.) Staff and graduate students at Indiana University's School of Public and Environmental Affairs (SPEA) collect samples and field data during July and August of each year. Since this is when the lake water column naturally stratifies, sampling at this time represents worst-case conditions for lake water quality. Such sampling is consistent with past monitoring and assessment efforts in Indiana, as well as past and current efforts elsewhere.

Sampling consisted of collecting a single set of water samples from the deepest portion of each lake. Sample analyses were conducted per methods outlined in the 18th edition of *Standard Methods for the Examination of Water and Wastewater* (APHA 1992). Dissolved oxygen, pH, and water clarity readings were taken in the field at the time of sampling. All other chemical analyses and plankton counts were completed in the SPEA lab in Bloomington.

The Indiana Trophic State Index (TSI) is used to assign points for each of ten common water quality parameters. The total of these points for a particular lake is that lake's trophic or TSI score. Scores range from 0 to 75, with the lower numbers indicating waters with the least amount of nutrient enrichment.

For nearly 30 years, Indiana lakes and reservoirs have been divided into three classes (trisections) based on trophic scores. Class I lakes are the least impacted by nutrients, scoring between 0 and 25 points on the Indiana Trophic State Index. Class II lakes (26-50 points) show an intermediate amount of nutrient enrichment. Class III lakes score 51 to 75 points and demonstrate the highest level of enrichment or eutrophication. A fourth lake class, which included remnant and oxbow lakes, is no longer used. Waterbodies once listed in this class are more typical of wetlands than lakes, and should be of interest to those programs.

In keeping with the information being entered into EPA's Waterbody System, on which this report relies, Indiana's lakes are divided here into five classes (pentasections) of equally-sized point ranges. Such methodology seems consistent with Indiana's usual trisection of lake data, as mentioned above. The lake classes used here, in order of increasing eutrophication, are:

- oligotrophic 0-15 points on the Indiana TSI scale;
- mesotrophic 16-30 TSI points;
- eutrophic 31-45 TSI points;
- hypereutrophic 46-60 TSI points; and
- dystrophic 61-75 TSI points.

During the 1996 and 1997 monitoring years, Indiana lakes ranged from a low score of 2 points (Gambill Lake, Sullivan County) to a high of 58 (Greensburg Lake, Decatur County). The average trophic score statewide was 26; which is in the mesotrophic class (or at the extreme low end of Class II in the Indiana scheme). Lakes that appear to have had significant increases in nutrients, which could ultimately lead to degraded water quality, are:

McClish Lake	Steuben County	28 point increase
Mollenkramer Reservoir	Ripley County	26 point increase
Lake of the Woods	LaGrange County	25 point increase

Lakes showing significant decreases in nutrient concentrations (with possible improvements in overall water quality) include:

Prairie Creek Reservoir	Delaware County	31 points decrease
Green Valley Lake	Vigo County	28 points decrease
Little Otter Lake	Steuben County	24 points decrease

Of the lakes assessed in 1996-97, approximately 26% fell into the oligotrophic category, 38% were classified as mesotrophic, 25% as eutrophic, and approximately 12% as hypereutrophic. None landed in the dystrophic class (Table 15 and Figure 1). When we look at the acreage involved in each of these classifications, rather than the number of lakes, we see that only 9% of the lake acreage fell into the oligotrophic category; while the next three classes–in order–contained 69%, 19%, and 3% of the acreage assessed in 1996-97.

Table 15
Trophic Status of Significant Publicly-Owned Lakes

	Number of Lakes	Acreage of Lakes
Total	600+	106,000+
Assessed	164	54,153
Oligotrophic	42	4,761
Mesotrophic	62	37,389
Eutrophic	41	10,205
Hypereutrophic	19	1,798
Dystrophic	0	0

One of the things indicated by the two sets of percentages above is that there are numerous, small impoundments in this area of the state which are relatively low in nutrients. This is consistent with the fact that many of the counties sampled during 1996-97 are areas of mine land reclamation work; where many small recreational lakes have indeed been recently created. There are, still, a fair amount of waterbodies in these parts of Indiana which continue to be highly acidic due to mine spoil leachate. At this time, nutrient enrichment is low on the list of concerns being addressed with these particular lakes.

It is important to note that, with the current targeted sampling design, results of an entire five-year cycle must be taken into account before attempting to draw conclusions about lake water quality in the state as a whole. Use of a purely random, therefore unbiased, sampling design might help answer statewide lake water quality questions more rapidly. But such information would be of little value to individuals interested in specific waterbodies. As it stands, efforts are being made to more closely align the five-year rotation of lake assessments with IDEM's current surface water monitoring strategy. The goal is to enable the comparison of the assessed water quality of lakes with that of adjoining rivers and streams. Switching to a random sample design in order to cover a larger scale more rapidly may be possible in the future. Perhaps, when more local initiative is taken to monitor and assess individual lakes in a consistent and ongoing manner, this will be possible.

Based on lake monitoring efforts to date, Indiana is just beginning to have enough data points to do some cursory trend analysis. Of the lakes sampled during this period, 44% (42% of the acreage) appear to be stable; they are neither losing nor gaining in levels and effects of nutrients (Table 16). Nine percent of the lakes (16% of the acres) show some water quality improvement due to decreasing eutrophication; while 13% of lakes (37% of acres) show degraded water quality due to increasing eutrophication. Acreage-wise, this portion of Indiana showed a 21% net loss of water quality. The water quality trend is unknown for 34% of the lakes (only 6% of the acreage). A lack of trend detection here may be due to insufficient data points for a particular lake (i.e. it is new or was never sampled in the past). Lack of detectable trends can also be due to sampling error, methodology, abnormal seasonal effects, or changing activities in the surrounding watershed.

Table 16
Trends in Trophic Status for Publicly-Owned Lakes

	Number of Lakes	Acreage of Lakes
Assessed for Trends	164	54,153
Improving	15	8,474
Stable	72	22,569
Degrading	22	19,936
Unknown	55	3,174

While aquatic life cannot flourish or even survive without some nutrient input, accelerated eutrophication has long been identified as having the greatest negative impact on our nation's lakes; followed closely by sedimentation. Yet nutrients remain just one of the myriad problems facing lakes today. For instance, concerns over fish and sediment contaminants, while not a direct measure of current water column conditions, continue to effect perceptions of the value and usefulness of Indiana lake resources. Other issues, such as overcrowding and boating safety, are often identified by the public as being equally as critical as concerns over water quality. In fact, overuse problems can often compound poor lake water quality by resuspending pollutants into the water column, as well as adding to the daily pollutant load.

As suggested earlier, far more locally-led initiatives combining government, corporate, and citizen skills and resources will be needed before major improvements can be realized. Until then, the ability to assess the causes and effects of problems like lake eutrophication, as well as the ability to address and control the sources of these problems, should improve with time.

Another key effort being undertaken by IDEM at this time, in conjunction with a sister program at the Indiana Department of Natural Resources, is the development of a combined lake database. An electronic repository of information and data from both agency's various lake programs has been sorely needed within the state. It is hoped that information on lake restoration and pollution control efforts, as well as future water quality assessments, will be made more accessible via such a database; increasing the accuracy and completeness of reports such as this.

Wetlands Assessment

The Indiana Department of Environmental Management (IDEM) administers the Clean Water Act Section 401 Water Quality Certification (WQC) Program. IDEM regulates the placement of fill materials, excavation (in certain cases), and mechanical clearing of wetlands and other waterbodies. IDEM draws its authority from the federal Clean Water Act and from Indiana's water quality standards. IDEM regulates activities in conjunction with the U.S. Army Corps of Engineers.

Any person who wishes to place fill materials, excavate or dredge, or mechanically clear (use heavy equipment) within a wetland, lake, river, or stream must first apply to the Corps of Engineers for a Clean Water Act Section 404 permit. If the Corps of Engineers decides a permit is needed, then the person must also obtain a Clean Water Act Section 401 water quality certification from IDEM.

Under Clean Water Act Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's water quality standards. The applicant may be required to avoid impacts, minimize impacts, or mitigate for impacts to wetlands and other waters. IDEM will deny water quality certification if the activity will cause adverse impacts to water quality. A person may not proceed with a project until they have received a certification from IDEM. A key goal of the program is to insure that all activites regulated by IDEM meet the no-net-loss of wetlands policy.

Development of Wetland Water Quality Standards

Protecting the quantity and quality of the Nation’s wetland resources is a high priority. Wetland water quality standards are currently under development in Indiana. These standards will contain use classifications, narrative criteria, and an antidegradation policy.

Integrity and Extent of Wetland Resources

Wetlands occur in and provide benefits to every county in Indiana. The lack of quantitative information on some aspects of Indiana’s wetland resources is a major obstacle to improving wetland conservation efforts.

The most extensive database of wetland resources in Indiana is the National Wetlands Inventory developed by the U.S. Fish and Wildlife Service. Indiana’s National Wetlands Inventory maps were produced primarily from interpretation of high-altitude color infrared aerial photographs (scale of 1:58,000) taken of Indiana during spring and fall 1980-87. The maps indicate wetlands to type, using the Cowardin *et al.* Classification scheme. (U.S. Fish and Wildlife Service) The minimum size of a given wetland on National Wetland inventory maps is typically one to three acres. Very narrow wetlands in river corridors and wetlands under cultivation at the time of mapping are generally not depicted, and forested wetlands are poorly described.

The most recent and complete analysis of this database was conducted in 1991 by the Indiana Department of Natural Resources. According to the report, Indiana had approximately 813,000 acres of wetland habitat in the mid-1980s when the data were collected (Table 17). Wetland loss or gain since then is not known at this time. (IDEM 1994-95)

Table 17
Extent of Wetlands by Type
(rounded to nearest thousand acres)

Wetland type (Cowardin et al. 1979)	Historical extent (acres)	Most recent acreage (1991)
Palustrine scrub/shrub (PSS)		42,000
Palustrine forested (PFO)		504,000
:alustrine emergent (PEMB)		55,000
Palustrine emergent seasonally flooded (PEMC)		68,000
Palustrine emergent semi-permanently flooded (PEMF)		21,000
Palustrine open water (POW)		99,000
Lacustrine limnetic open water (L10W)		141,000
Riverine (R)		53,000
Total	5,600,000	813,000

Source: IDEM 1994-95.

Wetland Protection Activities

In the 1996-1997 reporting period, IDEM's Water Quality Certification Program, which is Indiana's primary tool for regulating adverse impacts to wetlands, reviewed a total of 922 applications for certification. Of these applications, 451 were approved in 1996, and 400 were approved in 1997. Forty-three were denied in 1996, and 28 were denied in 1997. In addition to the review of certifications, the program worked on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff work closely with the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. EPA, and the Indiana Department of Natural Resources to evaluate projects in planning and to coordinate requirements for various state and federal permits related to wetlands.
- IDEM staff began the process of drafting wetland water quality standards and implementation procedures through the Water Quality Certification Program. The standards are anticipated to include narrative biocriteria, antidegradation and use provisions. IDEM anticipates this rulemaking will extend into the early part of 2000.
- IDEM maintains a web page devoted to wetlands and water quality issues. This page is under development and is expected to include information on the status of Indiana's wetlands, current laws and rules, conservation programs, and links to other regulatory and non-regulatory wetland programs. The Water Quality Certification staff conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations protecting wetlands.

- IDEM is working closely with other regulatory agencies on the development of an interagency agreement which addresses key issues governing the use of wetland mitigation banks in Indiana.
- IDEM and the Indiana State Department of Health developed guidance regarding the construction and use of artificial wetlands for wastewater treatment.
- IDEM continues to work closely with all partners in the Indiana Wetland Conservation Plan. Part of the implementation phase of the Plan calls for the development of an Indiana-focused assessment protocol, which is slated for field testing during the summer of 1999 by IDEM and other regulatory agencies.

Wetland Mitigation Study

Wetlands play a vital role in the natural cycling of freshwater. Indiana has lost well over 80% of the pre-settlement wetland acreage. A study funded by a U.S. EPA Wetland Protection Grant is underway to evaluate wetland mitigation effectiveness. IDEM regulates jurisdictional wetlands through certification under Section 401 of the Clean Water Act. Compensatory mitigation is the effort by applicants to offset the negative effects of wetland destruction through the restoration or creation of another wetland. While a number of studies have shown the effectiveness of individual mitigation sites, other studies have discovered a serious lack of successfully constructed mitigation sites. In many cases the applicant did not even attempt to construct the promised mitigation (D'Avanzo 1989).

This study has been designed to evaluate the effectiveness of compensatory wetland mitigation in Indiana. The study is in two phases. All mitigation sites in the study will be inventoried in the first phase of the study and classified as either constructed, incomplete or no attempt. The second phase will include an acreage analysis, assessment of plant diversity and conservatism, and analysis of the problems which undermine mitigation efforts in Indiana.

The study is scheduled to last two years. Sites which meet the following criteria will be included in the study.

- A Section 401 certification from IDEM was granted or waived with conditions on or before December 31, 1996.
- The certification requires a specific acreage of wetland restoration or creation as compensatory mitigation.
- The mitigation is done by the applicant, or his subcontractors, and not as a fee simple donation.
- Wetland impacts have occurred by the observation date.
- Impacts are not a result of surface mining.

Each site which meets these criteria will be checked for compliance with the certification. Following this compliance check, a random sample of the completed sites will be studied in more detail to determine:

- The acreage of actual wetland replacement.
- The plant diversity and conservatism at the site.
- Problems which hinder site development.

Public Health/ Aquatic Life Concerns

The release of toxic materials into the aquatic environment can produce effects in several ways:

1. When present in sufficient amounts to be acutely toxic, they may directly kill fish and other aquatic organisms.
2. When present in lesser amounts, these substances can reduce densities and growth rates of aquatic organisms and/or bioaccumulate in their tissues until they are used for human consumption.
3. Toxic materials in the water could potentially affect human health by contaminating public water supplies.

At this time we have no data to indicate that there have been any adverse human health effects from contaminated water supplies due to toxic substances in surface waters.

In the last several years, advances in analytical capabilities and techniques, and the generation of more and better information as to the toxicity of these substances, have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Because many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column, much of the data on toxic substances used for assessments in this report was obtained through the fish tissue and surficial aquatic sediment monitoring program.

The Indiana Fish Consumption Advisory identifies fish species which contain toxicants at levels of concern for human consumption using the Great Lakes Task Force risk-based approach. The 1997 advisory is based on levels of polychlorinated biphenyl compounds and mercury found in fish tissue. While not all species of fish found in Indiana lakes and streams nor all waters have been tested, carp have generally been found to be contaminated with both polychlorinated biphenyls and mercury at levels of concern. For fish caught in waters not specifically listed in the Indana Fish Consumption Advisory, a general Group 2 advisory has been issued (one meal/week for general population and one meal/ month for women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15). (ISDH 1997)

Fish consumption use is reported separately from aquatic life use in order to provide better information due to the general fish consumption advisory for carp applicable to all Indiana rivers and streams which obscures other aquatic life use concerns. All waters of the state are under some level of consumption restriction for at least some species (i.e. carp). The total size of the various types of waterbodies that were monitored for toxics and determined to have elevated levels of toxics is shown in Table 18. It is expected that as more lakes and streams are monitored, toxicants will be found at levels of concern in the new samples (i.e., mercury and/or PCBs). The miles of streams and acres of lakes affected by toxicants are expected to increase in the near term.

Table 18
Summary of Total Waterbody Size Affected by Toxics

Waterbody Type	Units	Size Monitored For Toxics	Size with Elevated Levels of Toxics
Coastal Shoreline	Shoreline Miles	0.00	0.00
Estuary	Square Miles	0.00	0.00
Great Lakes Shoreline	Shoreline Miles	43.00	0.00
Lake, Reservoir	Acres	26006.00	0.00
Ocean	Square Miles	0.00	0.00
Other	No units	0.00	0.00
River	Miles	27730.18	1518.90
Wetlands, Freshwater	Acres	0.00	0.00
Wetlands, Tidal	Acres	0.00	0.00

A diverse healthy fish population is considered an indication of good water quality. Serious public concern is generated when dead and dying fish are noted in the aquatic environment since this is usually evidence of a severe water quality problem and may indicate the long-term loss of use of affected water as a fishery. A fish kill can result from the accidental or intentional spill of a toxic compound or oxygen-depleting substance into the aquatic environment. Fish kills may also occur downstream of a continuous industrial or municipal discharge which may release, due to a system upset, an atypical effluent containing high concentration of pollutants. Fish kills can also occur due to natural causes such as disease, extreme draught, or depletion of dissolved oxygen from extreme weather conditions.

A total of 49 fish kills was reported to IDEM’s Office of Environmental Response during 1996 and 1997. Of 2,381 spills logged by IDEM in 1996, 25 had associated fish kills. In 1997 there were 2,268 spills reported, 24 of which had associated fish kills.

GROUND WATER ASSESSMENT

Introduction to Indiana Ground Water

Ground water is a very important resource for Indiana citizens, agriculture, and industry. Nearly 70 percent of the state's population uses ground water for drinking water and other household uses. Approximately fifty percent of the population served by public water supplies depend on ground water as a source of water (IDEM 1997d). In 1996, 4149 public water supply systems supplied ground water to a population of approximately two million (IDEM 1997e). Over one-half million Indiana homes have private wells for their water supply. Ground water is also an integral component in Indiana's economy. Ground water is withdrawn at an average rate of 185 million gallons per day (mgd) for crop and turf irrigation. Industry withdraws an average 124 mgd of ground water, and over 25 mgd is used for energy production (Indiana’s Water Use, 1991 and 1992).

Indiana’s potable ground water occurs in both unconsolidated and bedrock aquifer systems. The most productive aquifers are associated with glacially derived outwash sand and gravel deposits that occur in the major river valleys. Other good unconsolidated aquifers are found in the thick, inter-till sand and gravel deposits and outwashes of central and northern Indiana. The withdrawal potential in unconsolidated aquifers is up to 2000 gallons per minute (gpm). The major bedrock aquifers include the Pennsylvanian Age sandstones of southwestern Indiana, Mississippian Age limestones in the south central area, Devonian Age limestones and dolomites across northern and central Indiana, and Silurian Age limestones and dolomites in the north and central portions of the state. Major bedrock aquifers yield up to 600 gpm.

The ambient ground water quality throughout Indiana is variable and dependent upon the aquifer system, geologic setting, and depth of geologic formation. In general, the incidence of mineralized or even saline ground water increases at bedrock depths that exceed 300 feet. The majority of private and public wells in Indiana occur at depths of less than 200 feet. The chemical quality of the potable water is generally adequate to meet the basic needs for household, municipal, industrial, and irrigation uses. However, the waters are often hard, with hardness exceeding 180 parts per million (ppm) as calcium carbonate. Other constituents of importance to natural water quality are iron, manganese, sulfate, and hydrogen-sulfide. The majority of Indiana's ground water exceeds the 0.3 ppm aesthetic threshold for iron, a level at which staining and a metallic taste to water may occur. Manganese concentrations are often a nuisance, causing black staining and deposits. Manganese concentrations are lowest along the Wabash and Whitewater River and in Mississippian Age limestone aquifers. Sulfate levels are dependent on the geologic deposits. Concentrations exceeding 600 ppm sulfate have been noted in Allen, Harrison, Orange, Vermillion and Lake counties. Hydrogen sulfide, which has an objectionable odor even at low concentrations, is produced from sulfate by oxidation-reduction reactions or biological reduction by anaerobic bacteria. It is generally present in the ground water underlain by limestone bedrock in northwestern regions of Indiana.

Ground Water Data for the 1998 305(b) Reporting Cycle

Ground water information contained in this report is based on guidelines provided and data requested by U.S. EPA (1997a). Among the information requested is an overview of the ten highest priority sources of ground water contamination in Indiana and the associated contaminants impacting ground water quality (Table 19) along with a summary of Indiana's ground water protection efforts (Table 20). Beginning with the 1996 305(b) report, the EPA requested that ground water quality be assessed for selected hydrogeologic settings or aquifers. In this report, ground water quality is summarized for five hydrogeologic settings or groups of settings as it relates to contaminant sources (Tables 21a-e) and the occurrence of particular groups of contaminants (Tables 22a-e).

For reporting period consistency throughout the 1998 305(b) report, only 1996 data has been summarized. Tables and their accompanying narratives focus on 1996 updates occurring since the 1996 305(b) report (IDEM 1994-95).

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water are listed by general activity types in Table 19. All sources listed are a potential threat to ground water; however, the degree to which the source is a threat to ground water depends on several factors, probably the most significant being ground water vulnerability. Other major risk factors include location of the contaminant source relative to drinking water sources, toxicity of contaminant, and the size of the population at risk. All risk factors listed in Table 19 were considered in selection of the ten priority contaminant sources, and those risk factors pertinent to the highest priorities are identified. Classes of contaminants commonly associated with each highest priority contaminant source are also given.

Table 19
Major Sources of Ground Water Contamination

CONTAMINANT SOURCE	HIGHEST PRIORITY	FACTORS[1]	TYPE OF CONTAMINANT[2]
Agricultural Activities			
Agricultural chemical facilities			
Commercial fertilizer applications	√	A, C, D, E	E
Confined animal feeding operations	√	A, D, E	E, J
Farmstead agricultural mixing and loading procedures			
Irrigation practices			
Manure applications			
Pesticide applications			

Table 19
Major Sources of Ground Water Contamination

CONTAMINANT SOURCE	HIGHEST PRIORITY	FACTORS[1]	TYPE OF CONTAMINANT[2]
Storage and Treatment Activities			
Land application			
Domestic and industrial residual applications			
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	√	A, B, C, D, E, F	B, C, D
Surface impoundments	√	A, C, D, E, F	A, B, C, D, E, G, H, J
Waste piles			
Disposal Activities			
Deep injection wells			
Landfills (constructed prior to 1989)	√	A, B, C, D, E, F	A, B, C, D, E, G, H, I, J
Permitted landfills (constructed 1989- present)			
Septic systems	√	A, C, D, E, F, G	A, B, C, D, E, H, J
Shallow injection wells	√	A, B, C, D, E, I	A, B, C, D, E, H, J
Other			
Hazardous waste generators			
Hazardous waste sites			
Industrial facilities	√	A, B, C, D, E, F	A, B, C, D, E, H, I, J
Liquid transport pipelines (including sewer)			
Materials spills (including during transport)	√	A, B, C, D, E, F	A, B, C, D, E, H, I, J
Material transfer operations			
Small-scale manufacturing and repair shops			
Mining and mine drainage			
Salt storage (State and nonstate facilities) and road salting	√	A, C, D, E, F	G
Urban runoff			

[1] Factors considered in selecting the contaminant source:
- (A) human health and/or environmental risk (toxicity)
- (B) size of the population at risk
- (C) location of source relative to drinking water source
- (D) number and/or size of contaminant sources
- (E) hydrogeologic sensitivity
- (F) documented State findings, other findings
- (G) high to very high priority in localized areas, but not over majority of Indiana
- (H) geographic distribution/ occurrence
- (I) lack of information

[2] Classes of contaminants associated with contamination source:
- (A) Inorganic pesticides
- (B) Organic pesticides
- (C) Halogenated solvents
- (D) Petroleum compounds
- (E) Nitrate
- (G) Salinity/ brine
- (H) Metals
- (I) Radionuclides
- (J) Bacteria
- (K) Protozoa
- (L) Viruses

Nitrate, a highly mobile and soluble contaminant, is the contaminant of concern from commercial fertilizer applications, concentrated animal feeding operations and septic systems. Nitrate is the most frequently detected ground water contaminant in rural areas; however, determining the source of nitrate can be difficult and costly. For the 1996 crop production season, nearly two million tons of commercial fertilizer were sold for application to the majority of 16 million Indiana acres (Indiana Agricultural Statistics Service 1995-96). Unlike pesticide use, purchase and use of commercial fertilizer is not regulated by the Office of the Indiana State Chemist. The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) assists crop producers in developing nutrient management plans. Some financial assistance is available for implementing Integrated Crop Management on farms. Concentrated animal feeding operations occur throughout Indiana, as livestock are an integral component of Indiana's economy. The Indiana Department of Environmental Management (IDEM) conducts a Confined Feeding approval program which requires large livestock and poultry producers to gain approval for construction and operation of their facilities; and NRCS also works closely with groups of livestock producers who request financial and technical assistance for building or expanding livestock operations. However, the anonymity of the source of nitrates in rural areas and the high concentration of manure (ammonia) which is converted to nitrate in feedlot areas cause confined animal feedlots to be a concern for contributing to ground water contamination. Septic systems are present throughout rural and unsewered suburban areas of Indiana. Improperly constructed, poorly maintained septic systems and septic systems occurring in ground water sensitive areas are also of concern.

Landfills and underground storage tanks are a high priority ground water contamination concern largely due to practices or activities that occurred prior to construction standards and legislation established for the protection of ground water. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since 1988, underground storage tank registration, upgrading, closure activity and site assessment have been closely reviewed by the IDEM Underground Storage Tank (UST) Section.

Discharges to surface impoundments such as pits, ponds, and lagoons are under regulated. In the highly vulnerable hydrogeologic settings identified in this report, many surface impoundments discharge neither to surface water nor have designed outfalls. Surface impoundments, many of them industrial, in the aforementioned hydrogeologic settings have a surface water to ground water discharge relationship that is close to 100 percent. Many of these surface impoundments have the potential to discharge metals, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs) to ground water. Other contaminants such as nitrates and salts have been documented to cause ground water contamination in Indiana.

Class V injections wells are widespread throughout the state and occur in high concentration in several areas including the highly vulnerable hydrogeologic settings occurring in St. Joseph and Elkhart Counties, O2S/O2E (Table 21b). Class V wells release a wide variety of contaminants into or above aquifers supplying drinking water. The large number and diversity of Class V wells combined with lack of information regarding effects of these wells on ground water pose a significant potential threat to ground water.

Several cases of ground water contamination due to industrial facilities or their ancillary operations have been documented in Indiana . Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs as a result of either accidents or intentional dumping of waste. Outreach and education programs have alleviated the majority of problems; however, these activities continue to be a major potential source of contamination to ground water in Indiana.

The storage and extensive use of salt as a deicing agent during the winter months has an impact on ground water. Ground water contamination from road salt has been documented in Indiana. Efforts are being made by the Indiana Department of Transportation (IDOT) to build salt storage facilities in areas where ground water is not sensitive to contamination and to upgrade existing facilities to protect ground water.

Approximately fifty spills are reported on the average to IDEM per week. In 1996, nearly 41 million gallons of chemicals, industrial wastes, and agricultural products spills were reported. Ground water contamination as a result of spills can be avoided or minimized if spills are properly handled and cleaned up. Unreported spills and improperly executed follow up efforts create a concern for ground water contamination.

Ground Water Protection Programs

Programs to monitor, evaluate, and protect ground water resources in Indiana occur at all levels of government. At the state level, several ground water protection programs and activities have been implemented or are in the process of being implemented. Table 20 lists the state's ground water protection programs and activities, developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

Table 20
Summary of State Ground Water Protection Programs (through 12/31/96)

PROGRAM OR ACTIVITY	STATUS	STATE AGENCY/ ORGANIZATION
Active SARA Title III Program	fully established	IDEM-OER
Ambient ground water monitoring program	pending	IDEM-OWM*, OISC
Aquifer vulnerability assessment	fully established	IDEM-OWM, IDNR, IGS, OISC
Aquifer mapping/basin studies	under development	IDNR, IDEM-OWM
Aquifer/ hydrogeologic setting characterization	fully established	IGS, IDEM-OWM, IDNR
Bulk storage program for agricultural chemicals	fully established	OISC
Comprehensive data management system	pending	IDEM-OWM
Complaint response program for private wells	fully established	IDEM-OWM
Confined animal feeding program	fully established	IDEM-OWM
EPA-endorsed Core Comprehensive State Ground Water	under development	IDEM-OWM, Governor's Ground
Ground water discharge permits for constructed wetlands	under development	IDEM-OWM
Ground water Best Management Practices	under development	OISC*, IDEM-OWM
Ground water legislation	fully established	IDEM, IDNR, OISC, ISDH
Ground water classification	under development	IDEM-OWM
Ground water quality standards	under development	IDEM-OWM
Interagency coordination for ground water protection	pending	Governor's Ground Water Task

Table 20
Summary of State Ground Water Protection Programs (through 12/31/96)

PROGRAM OR ACTIVITY	STATUS	STATE AGENCY/ ORGANIZATION
Land application of domestic and industrial residuals	fully established	IDEM-OWM
Nonpoint source controls	under development	IDEM-OWM
Oil and Gas	fully established	IDNR
Pesticide State Management Plan	under development	OISC*, IDEM-OWM
Pollution Prevention Program	fully established	IDEM-OPPTA
Reclamation	fully established	IDNR
Resource Conservation and Recovery Act (RCRA) Primacy	fully established	IDEM-OSHWM
Spill Monitoring	fully established	IDEM-OWM
State Superfund	fully established	IDEM-OSHWM/OER
State RCRA Program incorporating more stringent	fully established	IDEM-OSHWM
State septic system regulations	fully established	ISDH
Underground storage tank installation requirements	fully established	IDEM-OER
Underground Storage Tank Remediation Fund	fully established	IDEM-OER
Underground Storage Tank Permit Program	fully established	IDEM-OER
Underground Injection Control Program	fully established for	IDNR
Vulnerability assessment for drinking water/ wellhead	under development	IGS, IDEM-OWM
Well abandonment regulations	fully established	IDNR
Wellhead Protection Program (EPA-approved)	rule adopted	IDEM-OWM
Well installation regulations	fully established	IDNR

* indicates lead agency involved in enforcement or implementation

Acronyms Used:

IDEM Indiana Department of Environmental Management
DNR Indiana Department of Natural Resources
IGS Indiana Geological Survey
ISDH Indiana State Department of Health
OER Office of Environmental Response (IDEM)
OISC Office of the Indiana State Chemist
OPPTA Office of Pollution Prevention and Technical Assistance (IDEM)
OSHWM Office of Solid and Hazardous Waste Management (IDEM)
OWM Office of Water Management (IDEM)

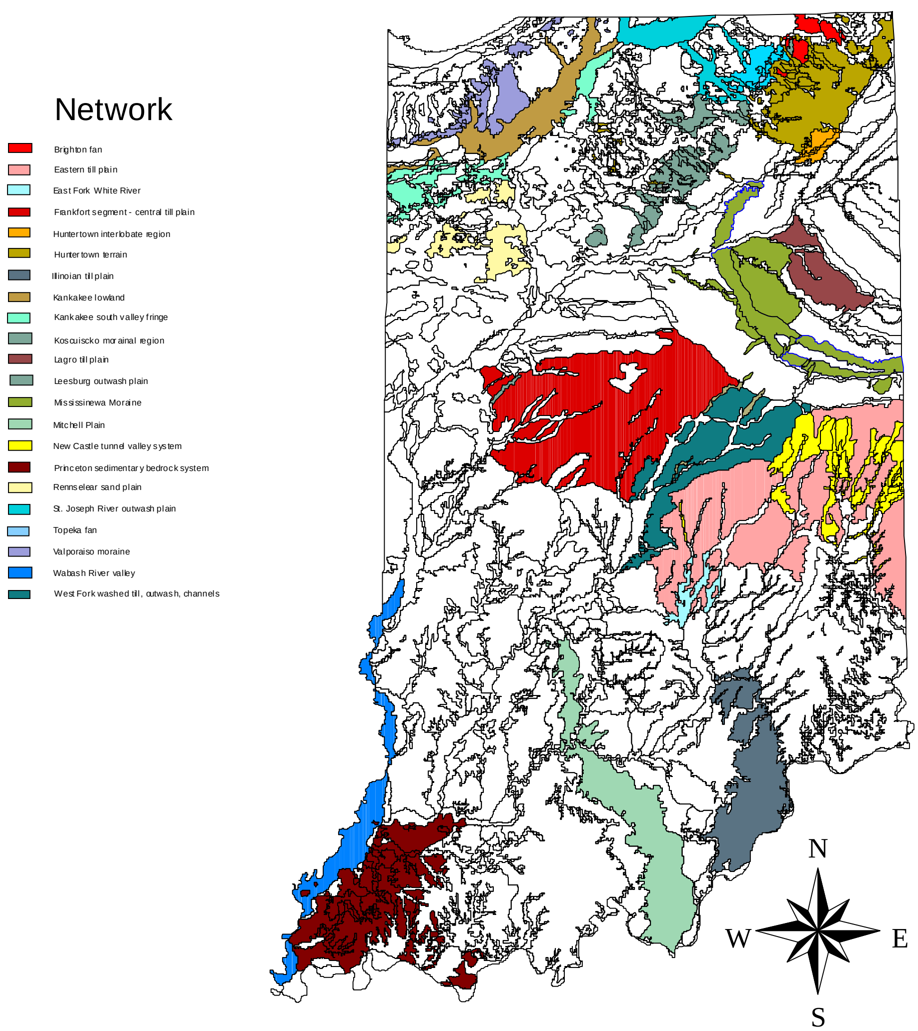
Definitions: “pending” is used to describe those programs that have a written, draft policy “under development” is used to describe those programs still in the planning stages

In 1996, progress in ground water protection efforts occurred in the Wellhead Protection Program. The Wellhead Rule was adopted by the Indiana Water Pollution Control Board on December 6, 1996, following the December, 1995, EPA-contingent approval of the Wellhead Protection Program. The Wellhead Protection Program is a proactive program that protects public water supplies from contamination and the Wellhead Rule outlines the minimum program requirements community public water supplies must meet to comply with the Wellhead Protection Program.

Also in 1996, areas to be sampled for the ground water monitoring network component of the State Pesticide Management Plan were identified, and voluntary participation of private well owners in those areas was solicited. Through cooperative efforts among the Office of Indiana State Chemist (OISC), Indiana Geological Survey (IGS), Indiana Department of Natural Resources- Division of Water (IDNR/DOW) and the IDEM, a monitoring network was established that would provide a statistical evaluation of trends in pesticide occurrence and concentrations in major hydrogeologic settings of the state. Of the 230 hydrogeologic settings identified by the IGS, approximately 60 were grouped into 22 “type” hydrogeologic settings that represented the state (Figure 4). The Indiana Department of Natural Resources provided private well records for wells in the hydrogeologic settings of interest; IDNR and IDEM geologists reviewed well records to determine if hydrogeologic setting criteria were met. Residents with wells fitting the hydrogeologic settings received information on the sampling program and volunteer participation was requested from approximately 1600 private well owners. Parameters to be monitored include pesticides, general chemistry, metals, and the hydrogen isotope tritium. Four hundred wells within the twenty-two hydrogeologic settings are to be monitored on a quarterly basis for seven quarters.

Figure 4

Hydrogeologic Monitoring Networks in Indiana



In 1996, local soil and water conservation districts in two Hydrologic Unit Areas (HUAs), in cooperation with the IDNR Division of Water and the Purdue University Cooperative Extension Service, promoted the plugging of abandoned wells through educational programs and materials. Nine well plugging demonstrations were performed at abandoned water well sites. Target audiences included local landowners that may have had abandoned wells on their properties, health department officials, realtors, farm managers, and other people interested in water quality. In addition, a video tape illustrating the plugging process was produced and distributed to all the regional extension offices; over 2,000 copies of extension publication WQ-21, “Plugging Abandoned Water Wells: A Landowner’s Guide,” were distributed; and contact was made with surrounding states (especially Michigan and Illinois) to share ideas concerning plugging wells.

A ground water protection program resides in the Ground Water Section at IDEM to protect and assist the private well owner. The Complaint Response Program receives over 400 calls annually from private well owners concerned with contamination of their drinking water from nearby sources. The Complaint Response Program also receives referrals from other IDEM program areas. Thirty-five sites (consisting of one or more private wells) were monitored for ground water contamination in 1996.

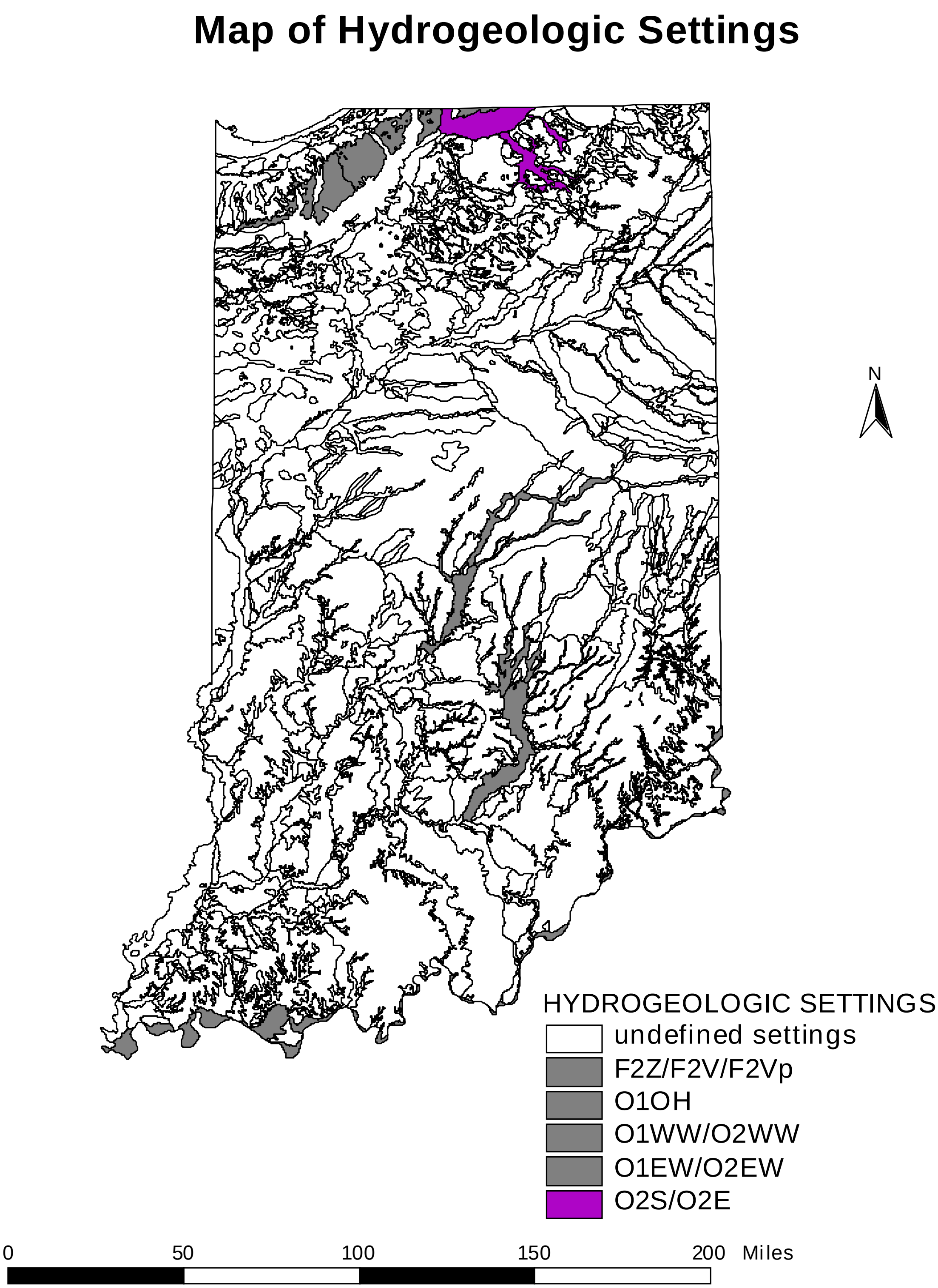
A ground water protection program is being developed at the county level with the use of nonpoint source 319 grant funds. A nutrient management program is being established for Lagrange County, a county with historical nitrate problems. Initiated and directed by the county health administrator, 1996 activities included mapping all well test data, constructing commercial and residential wetland systems for on-site treatment of contaminated ground water, and initiation of a manure ordinance.

Hydrogeologic Settings in Indiana

Ground water quality data can be better assessed when data is analyzed according to similar surface and subsurface environments rather than common political boundaries. In 1995, the Indiana Geological Survey (IGS) produced a document that describes the hydrogeologic settings occurring in Indiana. The hydrogeologic settings provide a conceptual model to interpret the sensitivity to contamination of ground water in relation to the surface and subsurface environment (Fleming and others 1995). Included in the analysis are the composition and geometry of the aquifers, thickness and variability of the confining units, surface and ground water interactions, and recharge/discharge relationships. The IGS compiled a set of 1:100,000 maps for the 35 quadrangles in Indiana designating the "distributions of hydrogeologic terrains, settings, and subsettings; generalized thickness of large sand and gravel aquifers; generalized thickness of glacial tills and other confining or capping units in areas of predominately confined aquifers; generalized depth to the water table, chiefly in areas of unconfined sand and gravel or alluvial aquifers; and depth to bedrock where it is less than 50 feet deep" (Fleming and others 1995).

Hydrogeologic settings are made up of a number of sequences (the aquifers themselves) that describe the sensitivity of the aquifers. For the purposes of this report, individual map units with similar geologic history, hydrogeologic terrains and settings, and identical vulnerability indices have been combined. As outlined in the EPA guidelines, hydrogeologic settings selected for this report were those that are vulnerable to contamination and contain largely populated areas (i.e., areas of greatest ground water demand). These units include OS2/O2E, O1OH, O1EW/O2EW, O1WW/O2WW, and F2Z/F2V/F2Vp. They are principally outwash deposits or fans of glacial origin as seen in figure 5 and are described following the figure.

Figure 5



O2S/O2E - The sequence, the St. Joseph River Outwash Plain (O2S), comprises a large outwash plain and glacial sluiceway that encompasses more than 250 square miles of northern Indiana and is contiguous to the Elkhart River Outwash system (O2E). The glacial sluiceway is a meltwater channel that is up to 100 feet thick whereas the outwash plain ranges from 25 to 50 feet in thickness. The combined total sequence can be more than 350 feet in thickness. The water table commonly ranges between five and fifteen feet below the land surface and many wells are hand driven. This sand and gravel outwash system forms an unconfined aquifer that is highly susceptible to contamination. Because of the degree of industrial development in the cities of Elkhart and South Bend, and areas between, this aquifer system exhibits more documented contamination per sampling event than any other in Indiana.

F2Z/F2V/F2Vp - The sequence F2Z is an exposed outwash fan that is present north of the St. Joseph River in Elkhart and St. Joseph Counties. The unit is more than 100 feet thick and well depths are commonly less than 70 feet deep. The water table in this unconfined unit is 15 to 30 feet below the land surface. This sequence is part of the larger Kalamazoo Morainal System that covers hundreds of square miles in southern Michigan. The sequence's F2V/F2Vp also represents exposed glacial fans in LaPorte and Porter Counties that formed as part of the Valparaiso Moraine derived from Michigan Lobe glacial events. These units were not deposited at the same time as the fan deposits of the Kalamazoo Morainal System, but do share similar geologic histories and structures. The sequence F2V and the previously noted sequence F2Z are exposed glacial fans that composed of sand and gravel deposits that can be in excess of 100 feet thick. The sequence F2Vp represents a pitted surface of sand and gravel deposits and peat and muck that formed from collapse of buried melting ice blocks. Valparaiso Moraine fan deposits have a shallow water table that is less than 40 feet, and in many areas less than 15 feet below the land surface. These sequences are highly susceptible to contamination; however, because of less industrial development, less contamination per sampling event is noted as compared to outwash and sluiceways of northern Indiana.

O1WW/O2WW - These sequences were formed as part of an anastomosing outwash system in which northeast to southwest trending outwash channels (O1WW) that reside between Muncie and Indianapolis coalesce to form a broad outwash plain (O2WW) between Indianapolis and the Wisconsin glacial margin north of Martinsville. The West Fork of the White River roughly parallels these sequences and contains episodic fan deposits that may be more than 100 feet thick. These sequences are regionally extensive unconfined sand and gravel aquifers with a water table that is typically less than twenty feet below the land surface. Limestone and dolomite are below and hydraulically connected to the outwash. Because these units are unconfined and industrialized they exhibit a high ratio of contamination detected per sampling event.

O1EW/O2EW -The East Fork of the White River is underlain by a broad outwash plain (O2EW) that is twelve miles wide and is commonly more than 100 feet thick. In addition, this sequence may contain small fan deposits. It originated as several smaller glacial sluiceways (O1EW) north of the outwash in the central till plain. These sequences begin near Columbus and continue for 30 miles southward. The water table is shallow in this unconfined system and ranges from five to twenty feet below the land surface in the outwash. Because these sequences are vulnerable to contamination and are in areas of agricultural production, more contamination related to farming practices was noted per sampling event than in other areas.

O1OH - The Ohio River Outwash sequence is more than 200 miles long in Indiana and is up to 12 miles wide near Mt. Vernon. This sequence formed as a result of carrying meltwater for pre-Wisconsin and late Wisconsin glaciation. The outwash is up to 200 feet thick and is capped by ten to twenty feet of alluvium. The water table ranges from five feet below the land surface to as much as fifty feet under the sand and gravel terraces that flank the valley walls. This highly vulnerable sequence exhibited contamination in the industrialized areas of Jeffersonville and Evansville whereas the relatively unpopulated areas between have not been documented as contaminated.

Summary of Ground Water Contamination Sites

Type and frequency of contamination sites occurring in each selected hydrogeologic setting or setting group are reported in Tables 21a-e. Organization of this data per setting permits a better understanding of the stress occurring to the individual hydrogeologic setting. Geographic Information System (GIS) analyses were used in determining the number of CERCLIS, RCRA corrective action, and voluntary remediation sites that occurred within each hydrogeologic setting grouping. Approximately eighty percent of the sites in each of the aforementioned program areas have been geolocated; therefore, number of sites may be underestimated. Map interpretations were performed in determining the number of Superfund and State Cleanup sites per hydrogeologic setting. For program areas in which Universal Transverse Mercator (UTM) or latitude/ longitude coordinates were not available for GIS analysis, sites having mailing addresses containing cities that were entirely or partially within a hydrogeologic setting were included. Due to this gross method of calculating number of sites, spill, leaking underground storage tanks, and underground injection wells site numbers are most likely overestimated. Accuracy of site information should increase in future reports as GIS continues to be incorporated into all IDEM program areas.

Although total area varies among the five hydrogeologic setting groups, a broad comparison of the total number of contamination sites listed indicates that ground water in the highly industrialized and/or highly populated settings, O2S/O2E and O1WW/O2WW, has a much greater chance of being impacted by contamination sources than ground water in the less populated, less industrialized settings, F2Z/F2V/F2Vp, O1EW/O2EW, and O1OH. Volatile organic compounds are the primary constituent of ground water contamination in all five hydrogeologic units. Potential sources of ground water contamination such as agricultural distribution centers, surface impoundments, road salt storage facilities, and confined animal feedlots should also be considered when determining overall stress to the hydrogeologic setting.

Table 21a
Summary of Ground Water Contamination Sites
Exposed outer fan of Valparaiso Moraine and exposed outwash fan of Kalamazoo Morainal System
Southeastern Lake, LaPorte, eastcentral and southeastern Porter, northern St. Joseph Counties, Indiana

Map Unit(s): F2Z, F2V, F2Vp **Data Reporting Period**: 1/1/96 - 12/31/96

Source Type		Number of sites in area that are listed and/or have confirmed releases	Number of sites with confirmed ground water contamination	Contaminants
Superfund		1	1	VOC's
CERCLIS (non-NPL)		40		VOC's, SOC's, Metals
DOD		1	1	VOC's
LUST		85	19	VOC's
RCRA Corrective Action		5		VOC'S, SOC's, Metals
UIW	Class I	1		Ammonia, Metals, Chloride
	Class II	0	0	
	Class III	0	0	
	Class V[1]	23		VOC's, Nutrients, Metals,
State Cleanup		0	0	
Voluntary Cleanup		2		VOC's, Metals
Material spills		29		VOC's, SOC's, Nutrients, Metals,
Total		187		

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
UIW= Underground Injection Wells
[1] Reporting period ending 12/31/95

Table 21b
Summary of Ground Water Contamination Sites

St. Joseph River outwash plain, Elkhart River outwash system
Northern and central Elkhart, northeastern Kosciusko, northwestern Noble, northwestern and north central St. Joseph Counties, Indiana

Map Unit(s): O2S, O2E **Data Reporting Period**: 1/1/96 - 12/31/96

Source Type		Number of sites in area that are listed and/or have confirmed releases	Number of sites with confirmed ground water contamination	Contaminants
Superfund		3	3	VOC's, Metals
CERCLIS (non-NPL)		55		VOC's, SOC's, Metals
DOD		0	0	
LUST		238	48	VOC's
RCRA Corrective Action		18		VOC's, SOC's, Metals
UIW	Class I	1	1	Acids, Metals
	Class II	0	0	
	Class III	0	0	
	Class V[1]	760		VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		2	2	VOC's
Voluntary Cleanup		13		VOC's
Material spills		75		VOC's, SOC's, Nutrients, Metals, Pesticides, Hazardous Materials
Total		1165		

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
UIW= Underground Injection Wells
[1] Reporting period ending 12/31/95

Table 21c
Summary of Ground Water Contamination Sites

Hydrogeologic Setting(s): White River West Fork outwash system and outwash plain

Map Unit(s): O1WW, O2WW

Counties included: southeastern Boone, southwestern Delaware, eastcentral Hamilton, northwestern Johnson, central and southwestern Madison, Marion, northeastern Morgan

Data Reporting Period: 1/1/96 - 12/31/96

Source Type		**Number of sites in area that are listed and/or have confirmed releases**	**Number of sites with confirmed ground water contamination**	**Contaminants**
Superfund		4	4	VOC'S, SOC's, Metals
CERCLIS (non-NPL)		44		VOC's, SOC's Metals
DOD		2		VOC's
LUST		992	238	VOC's
RCRA Corrective Action		14		VOC's, SOC's, Metals
UIW	Class I	0	0	
	Class II	0	0	
	Class III	0	0	
	Class V[1]	55		VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		3	3	Metals
Voluntary Cleanup		5		VOC's, Metals
Material spills		303		VOC's, SOC's, Nutrients Metals, Pesticides Hazardous Materials
Total		1422		

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
UIW= Underground Injection Wells
[1] Reporting period ending 12/31/95

Table 21d
Summary of Ground Water Contamination Sites

Hydrogeologic Setting(s): White River Upper East Fork sluiceway and outwash plain

Map Unit(s): O1EW, O2EW

Counties included: central and western Bartholomew; central and western Jackson; southeastern Johnson; western Shelby

Data Reporting Period: 1/1/96 - 12/31/96

Source Type		Number of sites in area that are listed and/or have confirmed releases	Number of sites with confirmed ground water contamination	Contaminants
Superfund		3	3	VOC's, Metals
CERCLIS (non-NPL)		6		VOC's, SOC's, Metals
DOD		1		
LUST		79	23	VOC's
RCRA Corrective Action		1		VOC's
UIW	Class I	0	0	
	Class II	0	0	
	Class III	0	0	
	Class V[1]	16		VOC,s Nutrients, Metals, Pesticides, Septic
State Cleanup		1	1	VOC's
Voluntary Cleanup		1		VOC's
Material spills		46		VOC's, SOC's, Nutrients, Metals, Pesticides, Hazardous Materials
Total		154		

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
UIW= Underground Injection Wells
[1] Reporting period ending 12/31/95

Table 21e
Summary of Ground Water Contamination Sites

Hydrogeologic Setting(s): Ohio River Valley

Map Unit(s): O1OH

Counties included: southern edges of the following: Clark, Crawford, Floyd, Harrison, Jefferson, Perry, Posey, Spencer, Switzerland, Vanderburgh, Warrick

Data Reporting Period: 1/1/96 - 12/31/96

Source Type		**Number of sites in area that are listed and/or have confirmed releases**	**Number of sites with confirmed ground water contamination**	**Contaminants**
Superfund		0	0	
CERCLIS (non-NPL)		16		VOC's, SOC's Metals
DOD		1	1	VOC's, Ordinance
LUST		325	66	VOC's
RCRA Corrective Action		4		VOC's, SOC's Metals
UIW	Class I	0	0	
	Class II[1]	125		
	Class III	0	0	
	Class V[1]	5		VOC's, Nutrients, Metals, Pesticides, Septic
State Cleanup		0	0	
Voluntary Cleanup		1		VOC'S
Material spills		123		VOC's, SOC's, Nutrients Metals, Pesticides, Hazardous Materials
Total		600		

NPL = National Priority List
CERCLIS= Comprehensive Environmental Response, Compensation, and Liability Information System
DOD= Department of Defense
LUST= Leaking Underground Storage Tanks
RCRA=Resource Conservation and Recovery Act
UIW= Underground Injection Wells
[1] Reporting period ending 12/31/95

Ground Water for Drinking Water Monitoring Data

Ground water quality data collected in 1996 is summarized per hydrogeologic setting in Tables 22a-e and separated according to data source. Data obtained from community and noncommunity public water supplies (PWS) was collected from Indiana's "Standardized

Monitoring Framework" (SMF) compliance results. Community and noncommunity nontransient systems are required to test for 12 inorganic chemicals (IOCs), 31 synthetic organic compounds (SOCs), and 21 volatile organic compounds (VOCs). All public water supply systems including noncommunity transient are required to test for nitrates. Only community systems are required to monitor for radionuclides. Radionuclide monitoring consists of analysis for gross alpha particle activity. Samples collected by PWS are from entry points which occur after treatment and before the distribution system. Entry point data can be from a single well or blended from two or more wells. Different monitoring schedules for the various parameters resulted in variability in number of entry points within a system type. SOC and IOC data generally represents new PWS systems as most established public water supply systems were between monitoring cycles for SOC's and IOC's.

An overall trend among ground water contaminants detected in PWS systems is the common occurrence of nitrates throughout all five hydrogeologic settings. Frequency of nitrate detection was 28-63% for community systems and 32-61% for noncommunity systems with the highest frequency of nitrate detections occurring in the O1EW/O2EW and O1OH settings. VOC detections were more sporadic with the highest frequency of VOC detections (40%) occurring in noncommunity systems in O2S/O2E (discounting the only VOC sample taken and detected for noncommunity systems in O1EW/O2EW).

Tables 22a-e include a separate summary of ground water quality data originating from private wells that were tested for the Complaint Response Program. Private well water samples were taken before treatment and from a single well. A more extensive list of parameters was analyzed for private wells including over 100 VOCs, 60 SOCs and 30 metals. Limited data from private wells for the hydrogeologic areas selected makes it difficult to assess and compare ground water quality data among the various hydrogeologic settings; however, parameters tested in each setting is indicative of the contaminants of concern in that setting. Volatile organic compounds were a major contaminant of concern to private well owners in O2S/O2E with 37% of wells having VOC detections. An 11 well nitrate study was conducted in Jackson County (O1EW/O2EW) that resulted in 100 percent nitrate detection and 91% of detections greater than the nitrate Maximum Contaminant Level (MCL) of 10 ppm.

Table 22a
Summary of 1996 Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting(s): Exposed outer fan of Valparaiso Moraine and exposed outwash fan of Kalamazoo Morainal System
Map Unit(s): F2Z, F2V, F2Vp
Counties included: southeastern Lake, LaPorte, eastcentral and southeastern Porter, northern St. Joseph

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assess-ment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	26	VOC	23	3	1	0	0	0
	1	SOC	1	0	0	0	0	0
	26	IOC	26			0	0	0
	41	NO_3	30	9	2	0	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	19	VOC	19	0	0	0	0	12
	7	SOC	7	0	0	0	0	0
	19	IOC	19			0	0	0
	100	NO_3	68	11	13	8	0	0
		Radionuclides[5]						
Ground Water Quality Data from private wells [2]	4	VOC	1	3	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	Metals	0	0	0	0	0	0
	0	NO_3	0	0	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0

[1] PWS system data collected per entry point (narrative)
[2] Data collected from private wells in IDEM complaint response program , 10/1/95-12/31/96
[3] Action due to contaminated ground water (source water)
[4] Transient communities only required to monitor for NO_3
[5] Radionuclides not required for noncommunity systems

Table 22b
Summary of 1996 Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting(s): St. Joseph River outwash plain, Elkhart River outwash system
Map Unit(s): O2S, O2E
Counties included: northern and central Elkhart, northeastern Kosciusko, northwestern Noble, northwestern and north central St. Joseph

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assess-ment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	21	VOC	18	3	0	0	0	0
	10	SOC	9	1	0	0	0	0
	21	IOC	21			0	0	0
	48	NO_3	26	18	3	1	0	0
	4	Radionuclides	0	4	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	62	VOC	37	22	2	1	0	0
	23	SOC	23	0	0	0	0	0
	62	IOC	62			0	0	0
	265	NO_3	179	71	12	3	0	0
		Radionuclides[5]						
Ground Water Quality Data from private wells[2]	19	VOC	12	4	1	2	0	0
	2	SOC	2	0	0	0	0	0
	5	Metals	5	0	0	0	0	0
	0	NO_3	0	0	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0

[1] PWS system data collected per entry point (see narrative)
[2] Data collected from private wells in IDEM complaint response program, 10/1/95-12/31/96
[3] Action due to contaminated ground water (source water)
[4] Transient communities only required to monitor for NO_3
[5] Radionuclides not required for noncommunity systems

Table 22c
Summary of 1996 Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting(s): White River West Fork outwash system and outwash plain
Map Unit(s): O1WW, O2WW
Counties included: southeastern Boone, southwestern Delaware, eastcentral Hamilton, northwestern Johnson, central and southwestern Madison, Marion, northeastern Morgan

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assess-ment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	29	VOC	22	6	1	0	0	0
	3	SOC	3	0	0	0	0	0
	29	IOC	29			0	0	0
	59	NO_3	38	21	0	0	0	0
	2	Radionuclides	0	2	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	16	VOC	14	2	0	0	0	0
	4	SOC	4	0	0	0	0	0
	16	IOC	16			0	0	0
	220	NO_3	137	77	3	3	0	0
		Radionuclides[5]						
Ground Water Quality Data from private wells[2]	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	Metals	0	0	0	0	0	0
	0	NO_3	0	0	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0

[1] PWS system data collected per entry point (see narrative)
[2] Data collected from private wells in IDEM complaint response program, 10/1/95-12/31/96
[3] Action due to contaminated ground water (source water)
[4] Transient communities only required to monitor for NO_3
[5] Radionuclides not required for noncommunity systems

Table 22d
Summary of 1996 Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting(s): White River Upper East Fork sluiceway and outwash plain
Map Unit(s): O1EW, O2EW
Counties included: central and western Bartholomew; central and western Jackson; southeastern Johnson; western Shelby

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assessment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	12	VOC	9	2	1	0	0	0
	1	SOC	1	0	0	0	0	0
	12	IOC	12			0	0	0
	19	NO_3	7	10	2	0	0	0
	2	Radionuclides	0	2	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	1	VOC	0	1	0	0	0	0
	1	SOC	1	0	0	0	0	0
	1	IOC	1			0	0	0
	41	NO_3	16	15	5	5	0	0
		Radionuclides[5]						
Ground Water Quality Data from private wells[2]	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	Metals	0	0	0	0	0	0
	11	NO_3	0	0	1	10	0	0
	0	Radionuclides	0	0	0	0	0	0

1 PWS system data collected per entry point (narrative)
2 Data collected from private wells in IDEM complaint response program, 10/1/95-12/31/96
3 Action due to contaminated ground water (source water)
4 Transient communities only required to monitor for NO_3
5 Radionuclides not required for noncommunity systems

Table 22e
Summary of 1996 Ground Water for Drinking Water Monitoring Data.

Hydrogeologic Setting(s): Ohio River Valley
Map Unit(s): O1OH
Counties included: southern edges of the following: Clark, Crawford, Floyd, Harrison, Jefferson, Perry, Posey, Spencer, Switzerland, Vanderburgh, Warrick

Monitoring Data Type	Total No. of Entry Points[1] or Wells in Assess-ment	Parameter Groups	Number of Entry Points[1] or Wells					
			No detections above MDL	Detection > MDL and < 50% of MCL	Detection = or > 50% of MCL and < MCL	Detection = or > MCL	Removed from service[3]	Special Treatment[3]
Entry point Ground Water Quality Data from Community PWS	25	VOC	20	5	0	0	0	0
	1	SOC	1	0	0	0	0	0
	25	IOC	25			0	0	0
	30	NO_3	12	15	3	0	0	0
	0	Radionuclides	0	0	0	0	0	0
Entry point Ground Water Quality Data from Non-community transient[4] and non-transient PWS	6	VOC	5	1	0	0	0	0
	0	SOC	0	0	0	0	0	0
	6	IOC	6			0	0	0
	23	NO_3	10	13	0	0	0	0
		Radionuclides[5]						
Ground Water Quality Data from private wells[2]	0	VOC	0	0	0	0	0	0
	0	SOC	0	0	0	0	0	0
	0	Metals	0	0	0	0	0	0
	0	NO_3	0	0	0	0	0	0
	0	Radionuclides	0	0	0	0	0	0

1 PWS system data collected per entry point (narrative)
2 Data collected from private wells in IDEM complaint response program, 10/1/95-12/31/96
3 Action due to contaminated ground water (source water)
4 Transient communities only required to monitor for NO_3
5 Radionuclides not required for noncommunity systems

Future 305(b) Reporting Cycles

As IDEM and other agencies incorporate GIS analysis into their programs, determining ground water quality data and contamination site data will be much less complicated and results will be more accurate. Completion of the ground water database will also expedite acquisition of data. The database will store data collected and reported by state agencies on any well site throughout the state and will serve as the central clearinghouse for information pertaining to ground water in Indiana.

Ground water quality and contamination site data coverage for the 2000 and 2002 305(b) reports will increase by the addition of the 22 hydrogeologic groupings (or networks) to be monitored for the State Pesticide Management Plan. The rate at which ground water data coverage will increase beyond the 22 networks will be dependent upon GIS efforts and completion of the ground water database.

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